THE POPULATION-BASED MEASUREMENT OF QUALITY INDICATORS FOR SECONDARY PREVENTION OF STROKE IN SASKATCHEWAN

A Thesis Submitted to the College of Graduate Studies and Research in Partial Fulfillment of the Requirements for the Degree of Master of Science in the Department of Community Health and Epidemiology University of Saskatchewan, Saskatoon, SK

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ABSTRACT

In Saskatchewan, stroke is the third leading cause of death as well was the major cause of adult disability. Once a person suffers a stroke or transient ischemic attack (TIA), they are at high risk for having a secondary (or recurrent) stroke. Despite this knowledge, secondary stroke prevention is often overlooked in the care of stroke/TIA patients. With the vision of decreasing the incidence and impact of stroke in Saskatchewan, the Saskatchewan Integrated Stroke Strategy (SISS) was recently implemented. The purpose of this study is to begin the development of an evaluation measurement system for the SISS based on the guidelines and measures from the Canadian Stroke Strategy (CSS) specifically pertaining to secondary stroke prevention.

This multi-year cross-sectional study is an analysis of de-identified health data derived from linkage of administrative and laboratory data. Select indicators from the CSS Performance Measurement Manual involving medications use for secondary stroke prevention (antihypertensives, antilipidemics, anticoagulants) and intermediate health outcomes (serum LDL cholesterol, INR) are calculated. Regression is used to quantify the association of patient demographic and socioeconomic characteristics and geographic location of care with receipt of guideline-recommended secondary stroke prevention. The target population is Saskatchewan residents who have been hospitalized for a stroke or TIA between April 1, 2001 and March 31, 2008.

The results of this study indicated that secondary stroke prevention in Saskatchewan is sub-optimal in the management of hypertension, dyslipidemia, and atrial fibrillation. Although there has been some improvement over the time period, a significant number of patients are not taking the recommended medications at discharge from acute care. Similarly, a considerable number of patients are not receiving the appropriate laboratory tests within the year following their stroke event. Through regression analysis it was revealed that a number of correlates (ie. age, income, on medication before the stroke event) were significantly associated with receiving these specific elements of secondary stroke prevention, suggesting potential differences in provision of care. Finally, regional differences in secondary stroke prevention were found for a number of the outcomes, which may indicate differences in care throughout the province.

The findings of this study serve as a baseline for evaluation of the impact of the Saskatchewan Integrated Stroke Strategy in the area of secondary stroke prevention. The results make apparent the fact that secondary stroke prevention in Saskatchewan can be improved, and that there is much opportunity for future research in this area.

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DISCLAIMER

This study is based in part on the de-identified data provided by the Saskatchewan Ministry of Health, Saskatoon RHA, and Regina Qu'Appelle RHA. The interpretation and conclusions contained herein do not necessarily represent those of the Government of Saskatchewan, Saskatchewan Ministry of Health, Saskatoon RHA, or Regina Qu'Appelle RHA.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1: INTRODUCTION

Stroke is the sudden loss of brain function caused by the interruption of blood supply to the brain (1, 2). In Canada, more than 50,000 people suffer from a stroke each year and over 300,000 are currently living with the long-term effects (1). In response to the growing public health and economic issue of stroke in Canada, the Canadian Stroke Strategy was implemented through the joint cooperation of the Canadian Stroke Network and the Heart and Stroke Foundation of Canada (3, 4, 5). The goal of this program is to support an integrated approach to stroke prevention, treatment, and rehabilitation in every province and territory by 2010 (3). In accordance with the goal of the Canadian Stroke Strategy, the Saskatchewan Integrated Stroke Strategy was developed with the vision of decreasing the incidence and impact of stroke in Saskatchewan (6).

1.1 Study Rationale

In Saskatchewan, stroke is the third leading cause of death, as well as the major cause of adult disability (7). Approximately 2,000 people are affected each year in the province (6, 7) leaving many people disabled, impaired, and in the worst case, deceased. The risk of stroke doubles every ten years after age 55, and as the population continues to age, the number of people who suffer a stroke in the province is likely to increase (8).

To this point, stroke care in Saskatchewan has been suboptimal. There are a number of challenges and barriers to the delivery of quality stroke care in the province, including geography, make up of population, distribution of specialized health services, and public and professional awareness of stroke risk factors and symptoms (8). These factors have contributed to the stroke care in Saskatchewan being substandard, leaving a number of stroke patients without optimal care.

To address the deficiencies of stroke care in the province, and to be consistent with the goals of the Canadian Stroke Strategy, the Saskatchewan Integrated Stroke Strategy was recently developed (2003). The main goal of the program is to improve the provincial health care system in the way it deals with stroke across the continuum of care (6). The "continuum of stroke care" is defined by a number of components including primary prevention, hyperacute stroke management, acute stroke management, stroke rehabilitation, secondary prevention, and long-term recovery (5). This program, however, is still in the early stages, and only recently has a

pilot project commenced in the Sunrise Health Region (Yorkton, Saskatchewan). In order to monitor and evaluate the progress of this initiative, appropriate methods of evaluation are necessary.

Assessing the quality of stroke care across the continuum is a large undertaking. The focus was therefore narrowed down to one area, secondary stroke prevention, since it has important implications for future stroke events (1, 6, 9) and previously has not received appropriate attention within the province. Since it is known that secondary (or recurrent) stroke prevention in Saskatchewan is below ideal, it follows that a measurement system for quality of recurrent stroke prevention has yet to be developed. Saskatchewan needs a program of continuous measurement and reporting for secondary stroke to understand the current state of care, assess the impact of improvement efforts, and determine whether gains are being made (10). This program will allow for the assessment of the Saskatchewan Integrated Stroke Strategy, determining whether or not the efforts are improving the quality of secondary stroke prevention in Saskatchewan.

In secondary stroke prevention, prescription drugs are often important for the management of conditions, such as hypertension, dyslipidemia, and atrial fibrillation, which increase a person's risk of stroke (4). Access to data for filled prescriptions for patients in Saskatchewan is possible due to the existing provincial drug databases (see Appendix A) available at the Health Quality Council. By calculating the prescription drug indicators for hypertension, dyslipidemia, and atrial fibrillation, an understanding will be gained regarding management of these conditions with medications related to secondary stroke prevention. There is also a current lack of research regarding covariates for receiving secondary stroke care. The Health Quality Council has completed similar calculations for predictors in post heart-attack and diabetes care (11). By determining the factors and relationships that predict receiving evidence-based secondary stroke prevention, a better understanding will be gained regarding stroke prevention. Finally, the examination of the prescription drug indicators in each of the regional health authorities in Saskatchewan will determine the geographical differences in secondary stroke care in the province. Table 1.1 provides an introduction to relevant terms, acronyms, and information for the study.

Table 1.1: Introduction to Terms and Acronyms

Term	Acronym	Information/Definition
Angiotensin-Converting Enzyme Inhibitor	ACEI	A category of antihypertensive medication.
Canadian Best Practice Recommendations for Stroke Care		A document from the CSS that provides a synthesis of best practices in stroke care (4).
Canadian Stroke Strategy	CSS	
Denominator		The bottom portion of the indicator (fraction) which represents the whole; the number of parts into which the unit is divided.
Health Quality Council	HQC	An independent agency that measures and reports on quality of care in Saskatchewan, promotes improvement, and engages partners in building a better health system (12).
International Normalized Ratio	INR	A blood clotting test for the monitoring of people taking warfarin. The target for patients on the drug should be 2.5, range 2.0 to 3.0 (4).
Low Density Lipoprotein Cholesterol	LDL-C	A blood test that evaluates the LDL cholesterol level. The treatment target for stroke patients should be lower than 2.0 mmol/L (15).
Numerator		The top portion of the indicator (fraction) which represents the number of parts of the whole (denominator).
"On" Medication		If the time from the last dispensing date to the, for example, 90th day post-discharge was fewer than the number of days of available drug, then the patient was said to be "on" the particular medication at the 90th day post-discharge
Performance Measurement Manual		A document from the CSS that provides the framework for monitoring and evaluation of stroke services in Canada (5).
Quality Indicator/ Indicator		Measure how well a system may be performing, and in terms of healthcare allow for the quality of care and services to be evaluated (32, 33).
Researcher Documentation		The first part of the analysis plan used at the HQC that details how the numerators and denominators for indicators are to be developed. The document includes inclusion and exclusion criteria for indicators, as well as the rationale for the decisions made regarding the inclusion and exclusion criteria.
Saskatchewan Integrated Stroke Strategy	SISS	

Transient Ischemic Attack	TIA	Also known as a "mini-stroke", is a major warning sign of increased stroke risk (1, 13). Caused by a clot that induces short-term lack of blood supply to the brain (1, 14, 13)
Warfarin		A common blood thinning drug (anticoagulent) prescribed to prevent the formation of blood clots (16).

1.2 Objectives and Research Questions

The purpose of this study is to begin the development of an evaluation measurement system for the SISS, specifically in the area of secondary stroke prevention. The aim is first to describe stroke and TIA patients in Saskatchewan in terms of medication-related secondary stroke indicators. Second is to identify correlates of patients' receipt of specific elements of evidence-based secondary prevention in the population. Third is to determine if there is variation in secondary stroke care between the different regional health authorities in Saskatchewan.

This thesis addresses three major questions, and hypotheses are posited for each:

Question One: What is the quality of medically-driven secondary stroke prevention care in Saskatchewan, as indicated by process of care measures and intermediate patient outcomes in the areas of control of hypertension, lipidemia, and blood clotting among those at elevated risk of cerebral embolism? The quality of care in these areas will be measured based on indicators recommended in the CSS Performance Measurement Manual (5).

Based on evidence on the quality of secondary stroke care in previous research studies (1, 6, 9, 12) and evidence pertaining to secondary prevention of other vascular disease in Saskatchewan (11), it is hypothesized that half or fewer patients discharged from Saskatchewan hospitals following stroke will receive the recommended elements of secondary prevention studied here.

Question Two: What factors are associated with whether or not stroke and TIA patients receive evidence-based secondary stroke prevention in Saskatchewan? What is the strength of the relationship between those factors and the drug-related processes of care and intermediate outcomes (LDL-C and INR tests) reflected in the indicators?

Considering the results from the HQC Quality Insight report on post heart-attack and diabetes care (11), it is thought that there will be variations in quality of secondary stroke

prevention care related to such factors as age, gender, income, and urban/non-urban place of residence.

Question Three: Is there variation in quality of secondary stroke prevention among patients who reside in different Regional Health Authority areas in Saskatchewan?

Again, based on previous research (11) it is believed that there will be variation in secondary prevention between the different Saskatchewan Regional Health Authority Areas.

This type of research is important for various reasons. First, the SISS will need to assess whether or not their efforts in improving stroke care in the province are successful. This research will provide a baseline measurement concerning secondary stroke care in the province. Second, evidence of variations of evidence-based secondary stroke care in Saskatchewan will provide important information to focus efforts to improve and make equitable the secondary stroke prevention across the province. Overall, the results will be used to identify opportunities for, and monitor over time, quality improvement in the prevention of secondary strokes in Saskatchewan.

CHAPTER 2: LITERATURE REVIEW

2.1 Stroke

2.1.1 What is a Stroke?

A stroke is a sudden loss of brain function caused by the interruption of blood supply to the brain, usually by a blood clot or a blood vessel burst (1, 2). In the affected area, this disruption of blood flow cuts off the supply of oxygen and nutrients to the brain cells, causing cell death and damage to the brain tissue (1, 2). The amount of damage the brain incurs depends on the length of time the blood supply is interrupted, with the risk of permanent brain damage increasing over longer spans of hypoxia (1). The severity of the effects of a stroke depends on which part of the brain is affected and how much damage occurred (1,2). In the worst case, a very severe stroke can cause sudden death (2).

In Canada and Saskatchewan, stroke is a major health and economic concern. More than 50,000 people suffer from a stroke each year in Canada, and over 300,000 are currently living with the long-term effects (1). Stroke is also the third leading cause of death in the country with 14,000 people dying each year from the condition (1). Annually, stroke costs the Canadian economy at least $3 billion in physical services, hospital costs, lost wages, and decreased productivity (1, 17). Put in an individual context, the average acute cost of each stroke is an estimated $27,500 (1). In the province of Saskatchewan, the statistics are comparable. Stroke is the third leading cause of death, as well as the major cause of adult disability (7). Approximately 2,000 people are affected each year (7). Of these people, 300 die, 200 are so severely disabled they require long-term care, 800 are left with a moderate to severe impairment, 500 recover with a minor impairment or disability, and 200 fully recover (8).

2.1.2 Types of Stroke

According to a number of sources, there are two major types of stroke: ischemic stroke and hemorrhagic stroke (9, 14, 18, 19, 20). Transient ischemic attack (TIA) is also an important issue in stroke.

Ischemic stroke accounts for about 80% of strokes (1, 14). It is caused by an acute interruption of blood supply to the brain by a blood clot (1, 9, 14, 18, 19). This clot deprives downstream tissue of oxygen and nutrients (20), damaging that part of the brain. Ischemic strokes can be either “thrombotic” or “embolic” (1, 14) depending on the type of clot disrupting

the blood flow. Thrombotic strokes are caused by blood clots that formed in a brain artery; thrombi (1, 14, 18). Embolic strokes, on the other hand, are caused by blood clots that formed elsewhere in the body, called emboli, travelled via the bloodstream, and lodged in the brain (1, 14, 18). Both types of ischemic stroke are generally a result of atherosclerosis, the buildup of plaque in the arteries (1, 9).

Hemorrhagic stroke accounts for about 20% of strokes (1). It is caused by uncontrolled bleeding in or around the brain from broken blood vessels (1, 9, 14, 18). This flooding puts pressure on the brain, killing brain cells and causing damage (1, 18). Hemorrhagic strokes are classified according to the area of the brain the bleeding (hemorrhage) occurs. There are two main types, subarachnoid and intracerebral (1, 18, 12). Subarachnoid hemorrhage is when bleeding occurs on the surface of the brain underneath the thin outer membrane (1, 9, 18). Intracerebral hemorrhage, on the other hand, occurs when an artery ruptures deep within the brain (1, 9, 18). Both types of hemorrhagic stroke can be caused by structural problems that affect the blood vessels in the brain (1, 18). A couple of these problems include an aneurysm, a weakened area in the blood vessel wall that bulges and bursts, or arteriovenous malformations (AVM), which is the abnormality of tiny blood vessels causing the artery walls to be weak and break (1, 9, 18).

Transient ischemic attack (TIA), also known as a “mini-stroke”, is a major warning sign of increased risk for stroke (1, 13). It is caused by a clot that induces short-term lack of blood supply to the brain (1, 13, 14). The major difference between stroke and TIA is that the symptoms generally subside after a short period of time, often just minutes, and there is little or no damage done to the brain (1, 13). In Canada, approximately 15,000 people experience a TIA each year with many more going unreported (1). Since people who have had a TIA are five times more likely to have a stroke in the next two years (1), TIA is an important indicator for stroke prevention.

2.1.3 Effects of Stroke

Since a stroke occurs in the brain, it follows that the effects of stroke involve brain functions. Considering the brain controls every part of a person’s being, the effects of a stroke can manifest themselves in a large number of ways, meaning that no two strokes are ever the same (1, 9). A stroke can have devastating effects on many different aspects of a person’s life, including, but not limited to, ability to move, see, speak, reason, read and write (1). Besides

everyday tasks, a stroke can also have an affect on a person's emotions, memory, and personality (9, 18, 21). What factors affect a stroke patient's experiences, and their ability to rehabilitate, depends on where in the brain the stroke occurred, as well as the severity of the hypoxia and ensuing brain damage (1, 9).

No matter the effects, stroke is devastating for both the patients and the people who care about them; it is a major illness that changes people's lives (1, 9). Stroke leads to family stress, depression, lost income, decreased productivity, and increased care-giving responsibilities (3). First dealing with, and then recovering from stroke, is a difficult physical and emotional journey for both the survivors and their families. Rehabilitating from stroke takes a long time and is a very difficult process (21) requiring ongoing support from both healthcare systems and family members. Unfortunately, and despite best efforts, most stroke survivors only have the ability to recover to some extent (9); most will continue to live with lasting effects even after rehabilitation.

The struggles of stroke survivors is outlined in the project by the Heart and Stroke Foundation called "Never Giving Up: Stroke Survivor and Caregiver Perspectives on the Road to Recovery from Stroke" (8). Each person who has a stroke suffers different effects, and therefore has their own distinct struggles. For instance, one stroke survivor stated that "the hardest part of having a stroke is to accept my shortcomings, what I cannot do anymore, how things have changed, what I have lost" (8). Another stated that "what frustrated me the most was not being able to communicate" (8). Regardless, these people lost their way of being in the world (8) after stroke, and these profiles demonstrate the importance of stroke prevention, care, and treatment to decrease both the incidence of stroke, and its devastating effects.

2.1.4 Risk Factors for Stroke

It has been identified and well-documented that a large number of factors, both non-modifiable and modifiable, contribute to an individual's risk of having a stroke (19, 22). Non-modifiable risk factors are those that are out of a person's control, while modifiable risk factors can be influenced and changed by the individual (1, 14).

Even though non-modifiable risk factors are not subject to intervention or modification (19), they are important for identifying those who are at high risk of stroke (23). These individuals may benefit from preventative measures and/or more aggressive control of the modifiable risk factors (14, 23). The non-modifiable risk factors for stroke include: age, gender,

ethnicity/race, family history, and previous TIA or stroke event (1, 14, 19, 23). As with many other diseases, the risk for stroke increases with age (1, 14, 23); the risk of stroke doubles each decade after 55 years (14, 23). In terms of gender, stroke is more prevalent among men than women (23). Until they reach menopause, women are generally at lower risk for stroke (1). African Americans, self-described Hispanics, and Asians of Chinese and Japanese descent have been shown to have higher rates of stroke (14, 23). First Nations people are also at higher risk compared to the general population (1). There is an increased risk of stroke for people with close family members – parents, siblings, or children – who have a history of stroke (1, 23). Finally, if a person has previously experienced a stroke or TIA, they are at higher risk for having another stroke event in the future (1).

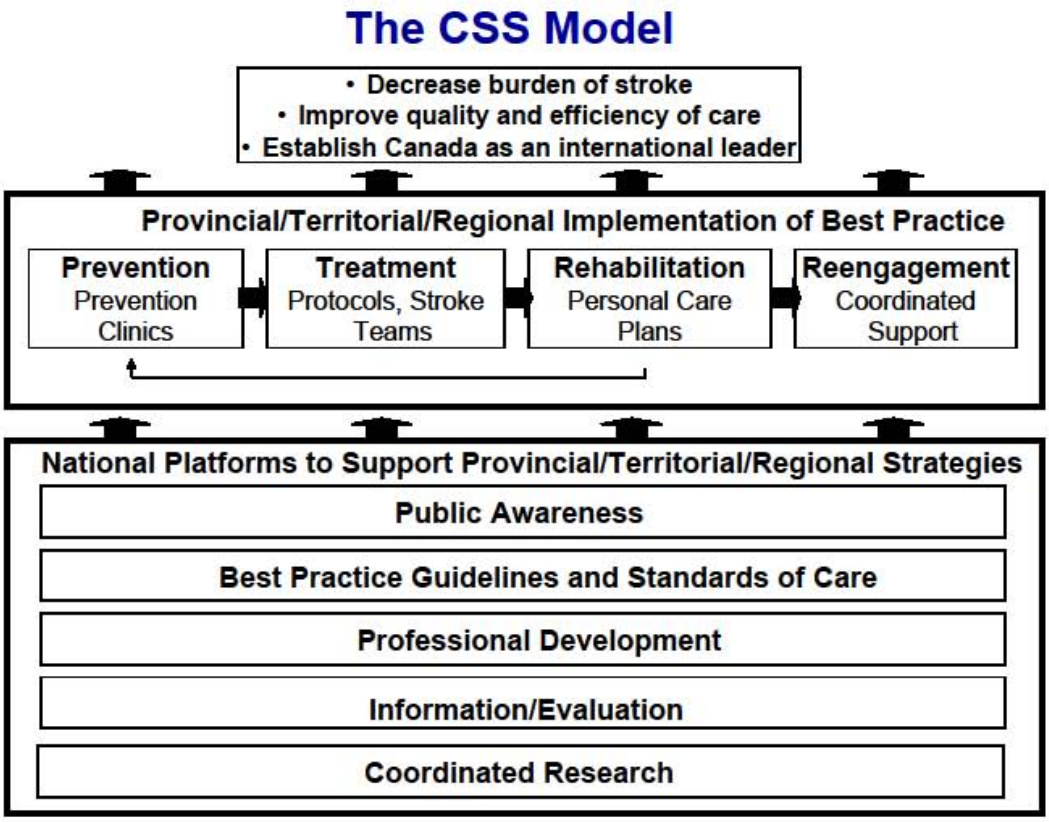
Modifiable risk factors are a critical aspect of stroke prevention as they are under the control of the individual. Management of these risk factors can reduce the incidence of stroke as well as the rate of death and dependence (14). There are a large number of modifiable risk factors, some well-documented, others with less evidence. Some of the well-documented modifiable risk factors for stroke include: high blood pressure, high blood cholesterol, dyslipidemia, atrial fibrillation, diabetes, diet, obesity, physical inactivity, smoking, and stress (1, 14, 23).

2.1.5 Prevention of Stroke

2.1.5.1 Canadian Stroke Strategy (CSS)

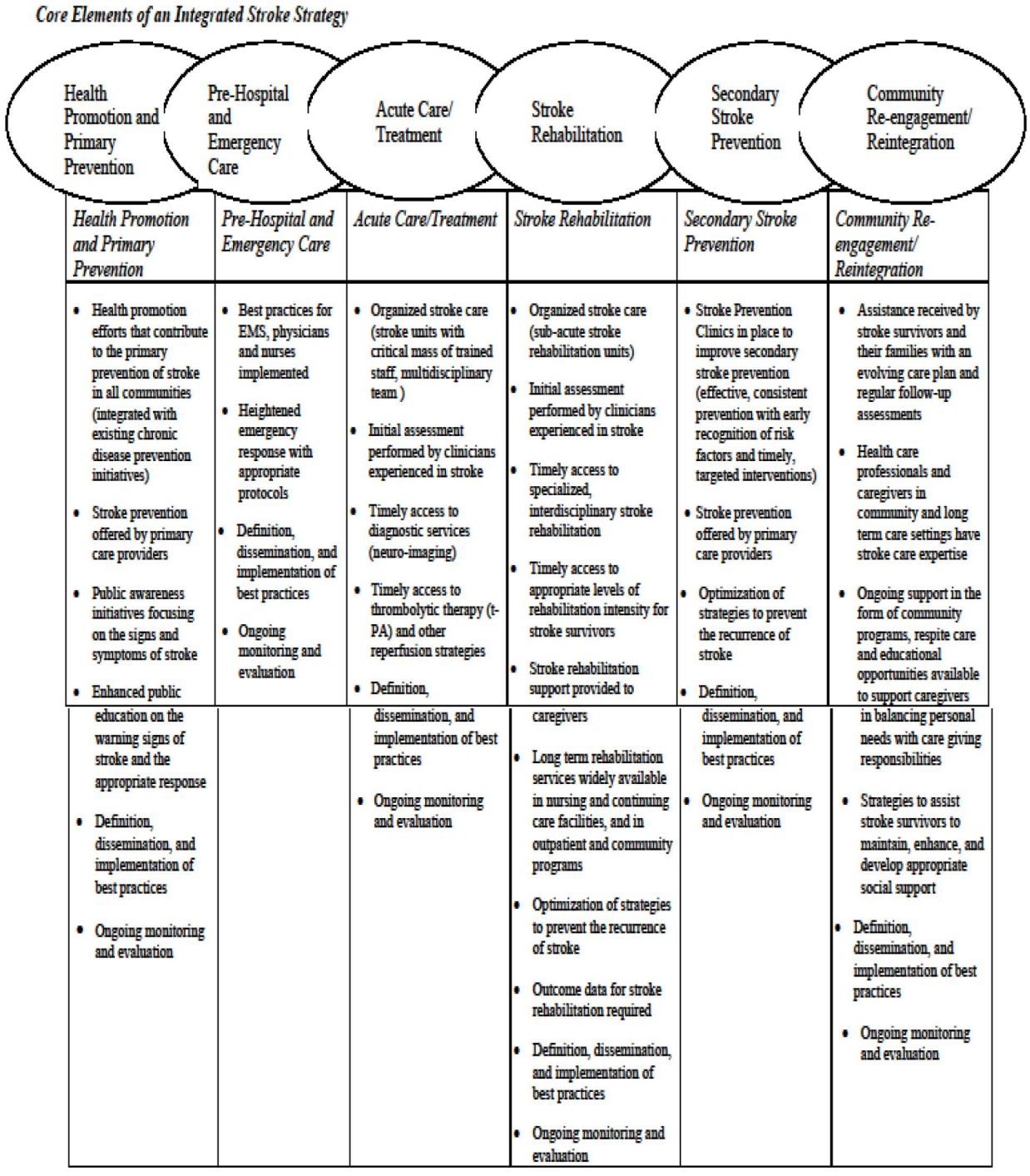
In recognition of and in response to the growing public health and economic impact of stroke in Canada, the Canadian Stroke Strategy was implemented through the joint cooperation of the Canadian Stroke Network and the Heart and Stroke Foundation of Canada (3, 4, 5). "The goal of the Canadian Stroke Strategy is to help support an integrated approach to stroke prevention, treatment, and rehabilitation in every province and territory by 2010" (3). Figure 2.1 illustrates the model of the Canadian Stroke Strategy.

Figure 2.1: Model of the Canadian Stroke Strategy (3)



It has been frequently reported that new research in stroke does not always reach health care providers, administrators, and most importantly, patients with stroke (3, 4). This lack of communication has left a significant gap in the quality of stroke care between what should be done and what is being done, meaning that best practices for stroke care are not always applied (3, 4). The Canadian Stroke Strategy responds to this problem, and supports the development of provincial stroke strategies across Canada to close the gap between evidence and practice along the full continuum of stroke care (3, 4). The "continuum of stroke care" is defined by a number of components including primary prevention, hyperacute stroke management, acute stroke management, stroke rehabilitation, secondary prevention, and long-term recovery (5). Figure 2.2 illustrates the core elements of an integrated stroke strategy that spans the continuum.

Figure 2.2: Core Elements of an Integrated Stroke Strategy (3)

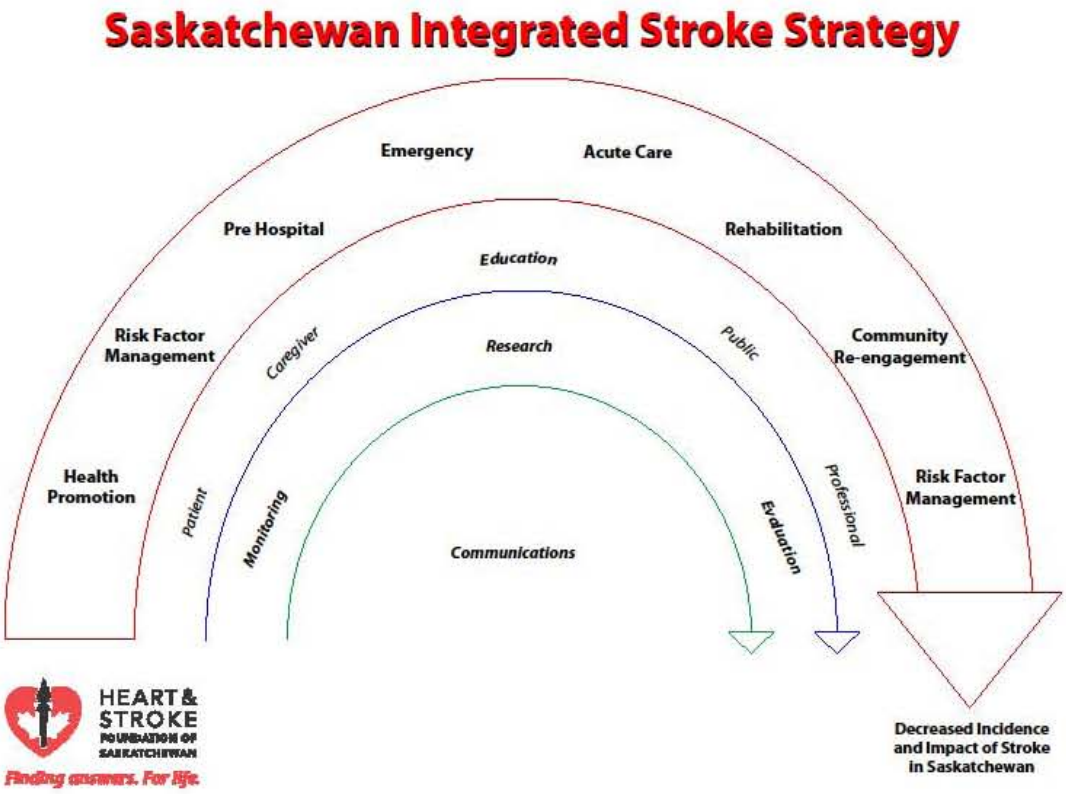


The Canadian Stroke Strategy has five national priority platforms, one of them being the Best Practices and Standards Working Group (3, 4). The goal of this platform is to ensure that evidence-based best practices for stroke prevention and care are integrated into the Canadian health system (4). The development of the Canadian Best Practice Recommendations for Stroke Care is a starting point in fulfilling this goal (3). The Best Practice manual, developed from extensive review of stroke research and guidelines, provides "…a synthesis of best practices in stroke care across the continuum and serves as a framework for provinces, territories, and regional health authorities as they develop and implement integrated stroke strategies" (5).

2.1.5.2 Saskatchewan Integrated Stroke Strategy (SISS)

In accordance with the goal of the Canadian Stroke Strategy, the Saskatchewan Integrated Stroke Strategy (SISS) was implemented with the vision of decreasing the incidence and impact of stroke in Saskatchewan (6). The goal of this initiative is to transform the health system in the way it views, prevents, and treats Saskatchewan stroke patients across the continuum of stroke care (6). This continuum includes health promotion, primary prevention, risk factor management, pre-hospital care, emergency care, acute care, rehabilitation, community re-engagement, and risk factor management post stroke and TIA (secondary prevention) (6). Figure 2.3 illustrates the model of the Saskatchewan Integrated Stroke Strategy.

Figure 2.3: Model of the Saskatchewan Integrated Stroke Strategy (6)



The development of the SISS has taken place through a collaborative approach by the Heart and Stroke Foundation of Saskatchewan (6). A provincial steering committee and expert working groups, a stroke prevention and care conference, and consultation visits with eleven health regions provided collaborative feedback and support to create the made-in Saskatchewan stroke strategy (6). In order to achieve best practices for stroke care, as suggested by the CSS, the steering committee created four working groups to provide suggestions and direction for implementation of the practices across the continuum of care (6). These recommendations are summarized in the "SISS Health System Transformation and Stroke Prevention and Care in Saskatchewan" report by the Heart and Stroke Foundation of Saskatchewan (6).

The SISS is still in its infancy, and only recently has a pilot project commenced in the Sunrise Health Region (Yorkton, Saskatchewan). As announced in a press release on December 17, 2008, the project will establish a stroke prevention clinic and improved stroke rehabilitation services with the goal of decreasing the incidence and impact of stroke in the health region (24). The ultimate goal in the province is to have an integrated provincial stroke strategy involving

every health region and every key area of stroke care (25). This pilot project is a starting point for this goal, with an at-risk area receiving immediate attention (25).

2.1.5.3 Ontario Stroke System (OSS)

The province of Ontario is ahead of Saskatchewan in creating a stroke strategy, and therefore serves as an example of where the SISS could be in future years. Similar to the SISS, the goal of the Ontario Stroke Strategy is to change the way stroke is viewed and treated in the province (26, 27). The Ontario government adopted and funded the program as a way to organize stroke services in the province and ensure that the people of Ontario had access to quality stroke care (26, 28). The strategy aims to decrease the incidence of stroke and improve patient care and outcomes for people who suffer a stroke (26, 27, 23). It is thought that this stroke care system will: i) ensure that all Ontarians have timely access to appropriate diagnosis and quality stroke care, and ii) respond more effectively and efficiently to those who are at risk for or who have had a stroke (26, 27). Since its inception this strategy has become known as the Ontario Stroke System (OSS). The OSS includes the full continuum of care within 11 regional stroke care systems across the province (27).

Since the implementation of the OSS and its regional network model of collaborative care, the stroke project has been deemed a success (28, 29). There have been significant improvements in the timeliness and quality of care (28). An evaluation of the program has demonstrated that the OSS has made positive measureable impacts on access to stroke-related services, the integration and coordination of stroke care, treatment for stroke, and client and provider satisfaction (27). Ontario has become recognized as a world leader in managing and treating people who have experienced a stroke (29). The OSS is identified as a successful model to emulate across Canada (27).

It should also be noted that other provinces in Canada have also started the process of creating an integrated stroke strategy. Information similar to the SISS can be found on the Alberta Provincial Stroke Strategy (APSS) (30) as well as the British Columbia Stroke Strategy (BCSS) (31).

2.2 Quality Indicators

2.2.1 What are Quality Indicators?

In recent years, assessing the quality of care has become increasingly important in healthcare systems (32). This measurement provides information regarding whether the quality of healthcare is good, excellent, or poor (33), and allows healthcare systems to determine what improvements are necessary. Since this assessment cannot be made directly, quality indicators are the tools by which this evaluation is made.

As stated by a number of different authors, defining and specifying "what is quality care" is often a difficult task (32, 34, 35, 36, 37). The formulation of quality healthcare can be narrow or broad, and can also depend on a number of different factors. As put by Donabedian (34), "…several formulations are both possible and legitimate, depending on where we are located in the system of care and on what the nature and extent of our responsibilities are". In other words, quality of care will generally be defined according to what level of care is being assessed. For the purposes of this project, quality of care is defined as "the degree to which health services for individuals and populations increase the likelihood of desired health outcomes and are consistent with current professional knowledge" (35).

Quality indicators measure how well a system may be performing, and in terms of healthcare allow for the quality of care and services to be evaluated (32, 38). Donabedian classified quality of care indicators into structure, process, and outcome (32, 34, 35). Structural indicators describe characteristics of the setting in which care takes place, for instance resources and staff (32, 34, 35), reflecting the system's ability to meet healthcare needs of the patients (32). Process indicators are concerned with what is done in giving and receiving care (32, 34, 35), an example being the proportion of diabetic patients given foot care (32). These assess what was done for the patient, and how well it was carried out (32). Finally, outcome indicators measure the effect of care on the health status of patients and populations (32, 34, 35). There are both intermediate and end results outcome indicators. Intermediate outcome indicators show changes in biological status that affect later health outcomes, an example being HbA1c lab tests for diabetics (32). End result outcome indicators reflect states of health or events that follow care, such as death, disability, and morbidity (32).

2.2.2 Quality Indicators and Stroke – Performance Measurement Manual

A supplement to the Best Practices Recommendations for Stroke Care is the Performance Measurement Manual (4, 5). Developed by the Information and Evaluation Working Group (IEWG), this manual provides detailed performance measures for the evaluation of the impact of provincial, regional, and local stroke activities and initiatives (5). It offers the framework for monitoring and evaluation of stroke services in Canada (5), specifically the impact of implementing the best practice recommendations on processes of care (5). The manual provides a list of performance measures along the continuum of stroke care, including primary prevention, hyperacute and acute stroke management, rehabilitation, secondary stroke prevention, and long-term recovery (5).

2.3 Quality Indicators in Secondary Stroke Prevention

2.3.1 What is Secondary Stroke Prevention?

If a person suffers a stroke or TIA, they are at high risk for having a secondary (or recurrent) stroke (6, 9). In fact, a stroke survivor has a 20% chance of having another stroke within 2 years (1). The chance of stroke recurrence depends on stroke etiology, and the treatment given after the first stroke event (6, 14). Considering the implications that interventions have for future stroke events, secondary stroke prevention is a critical, but often overlooked, aspect in the care of stroke or TIA patients.

"Secondary stroke prevention is an individually based clinical approach to reducing the risk of recurrent vascular events in individuals who have already experienced a stroke or TIA and in those who have one or more of the medical conditions or risk factors that place them at high risk of stroke" (4). In other words, secondary stroke prevention encompasses many different areas in the life of a stroke survivor. The secondary stroke recommendations made in the Best Practice manual are directed at the most relevant risk factors, including lifestyle, hypertension, dyslipidemia, previous stroke or TIA, atrial fibrillation, and carotid stenosis (4). Following a stroke or TIA, secondary stroke prevention should be addressed at all healthcare encounters on an ongoing basis (4).

2.3.1.1 Hypertension

Hypertension (elevated blood pressure) is the single most important modifiable risk factor for both first and recurrent stroke (4, 39). No other factor has been identified that

contributes more to the development of stroke (39). Table 2.1 provides a classification of blood pressure for adults aged 18 years or older. It has been reported that some 20-30% of the adult population and about 70% of stroke patients are affected by hypertension (39). In Canada, hypertension is a major problem (4) contributing to elevated stroke risk for many people in the country.

Table 2.1: Classification of Blood Pressure (BP) for Adults Aged 18 Years or Older (40)

BP Classification	Systolic BP, mmHg		Diastolic BP, mmHg
Normal	<120	and	<80
Prehypertension	120-139	or	80-89
Stage 1 Hypertension	140-149	or	90-99
Stage 2 Hypertension	≥160	or	≥100

The relationship between blood pressure and stroke risk has recently been recognized as being highly sensitive (41). A meta-analysis has shown that with each 2 mmHg reduction in systolic blood pressure, there is a 10% reduction in mortality from stroke (42). There is a continuous and linear relationship between blood pressure and risk of stroke (41, 43). This relationship is present not only in those who are hypertensive, but also those who are normotensive down to a blood pressure of at least 115/75 mmHg (42). Correspondingly, several controlled trials have demonstrated that reducing blood pressure decreased stroke risk among patients not normally classified as hypertensive (44, 45).

In secondary stroke prevention, hypertension is recognized as an important risk factor that should be controlled (46, 47, 48, 49). A number of trials have shown a 28% risk reduction in recurrent stroke in patients treated with blood pressure lowering medication (4). Antihypertensive therapy and lifestyle modification are the recommended strategies for recurrent stroke prevention (4, 46, 47, 48, 49). The Canadian Hypertension Education Program (CHEP) suggests that patients who have had a stroke or TIA be placed on blood pressure lowering treatment to a target blood pressure of less than 140/90 mm Hg (50).

2.3.1.2 Dyslipidemia

High blood cholesterol and lipids (dyslipidemia) is associated with an elevated risk for stroke (4). Unfortunately, it has been shown that significant numbers of patients are not properly evaluated and treated for this condition (51).

The relationship between dyslipidemia and stroke has been stated as being weakly positive and equivocal (48, 49, 52, 53). Despite these statements, it has been shown that lipid-lowering therapies offer a 25-30% relative reduction in primary and recurrent stroke risk (4). Several studies have shown the benefits of lipid-lowering therapy in the prevention of ischemic stroke, secondary stroke, and TIA (46, 52, 53, 54, 55, 56, 57, 58). The effects of therapy on hemorrhagic stroke, however, remain somewhat unclear (53, 56, 57, 58). It has therefore been stated that only people who have suffered an ischemic stroke or TIA should be placed on cholesterol-lowering medications (4).

Appropriate management of dyslipidemia by health care providers is imperative in secondary prevention of stroke (51). The Canadian Cardiovascular Society recommends that lipid-lowering therapy (generally statin agents) should be prescribed for patients who have had an ischemic stroke or TIA (15). High-risk individuals, this encompassing stroke and TIA patients, should have low density lipoprotein cholesterol (LDL-C) treatment targets lower than 2.0 mmol/L (15).

2.3.1.3 Atrial Fibrillation

Atrial fibrillation is a significant risk factor for stroke (4). This condition affects 1 to 1.5% of the general population in the Western world making it the most common type of cardiac rhythm abnormality in adults (59). People with atrial fibrillation have a fivefold increase in risk for stroke (59, 60). It has been shown that 1 in 6 patients with atrial fibrillation will experience a stroke in their lifetime (61). Strokes from atrial fibrillation are usually more severe and associated with an increased risk of morbidity, mortality, and poorer functional outcome than strokes from other causes (59).

There are a considerable number of papers stating the value of anticoagulants in reducing the risk of both primary and secondary stroke in people with atrial fibrillation (4, 16, 62, 63, 64, 65). Anticoagulant drugs, such as warfarin, make the blood ‘thinner’ and prevent the formation of blood clots, which in turn may prevent stroke (16). It has been reported that anticoagulant medications are superior to both antiplatelet agents and aspirin in both preventing and reducing the risk of stroke (16, 62, 63, 64, 64).

Following a recent ischemic stroke or TIA, anticoagulants should be prescribed to patients with atrial fibrillation to prevent secondary stroke (4, 16). A 68% relative risk reduction and a 33% absolute risk reduction in recurrent stroke has been found for patients who receive

anticoagulation with adjusted-dose warfarin (16, 66). It should be noted that this treatment pertains only to those who have had an ischemic stroke or TIA; the bleeding in hemorrhagic strokes generally renders anticoagulants unsuitable. Due to the nature of the medications, regular blood level monitoring is required to ensure patients are within the target range (4). Warfarin, one of the major anticoagulants, is assessed using the international normalized ratio (INR) (4). The target INR for patients on warfarin should be 2.5, range 2.0 to 3.0 (4).

2.3.2 Factors Associated with Secondary Stroke Prevention

Even though there is a publicly funded universal healthcare system in Canada, there exists evidence of unequal provision of medically necessary interventions (12). In secondary stroke prevention, research involving such inequalities is somewhat limited, but there have been papers published regarding factors related to differences in stroke prevention provision.

A Scottish study specific to secondary prevention of stroke found important sex- and age-related differences in care of patients with stroke (67). Men with ischemic stroke were prescribed antiplatelet therapy more often than women (67). Moreover, women with atrial fibrillation received warfarin less often than men (67). Also, older patients received antiplatelet therapy more often than younger patients (67). This evidence suggests that women and the elderly need to be targeted for secondary prevention therapy (67).

A number of studies have been conducted regarding gender differences in various aspects of stroke prevention. A couple of these papers have found there to be no major gender differences in stroke presentation, management, or access to care (12, 68). A different study found that women hospitalized for stroke had lower odds of receiving thrombolytic therapy treatment and lipid investigation (69). Yet another study found that, at discharge, women received antithrombotic stroke prevention less often than men (70). A final study found that anticoagulants were underused in older women with atrial fibrillation relative to older men with atrial fibrillation (71). It is clear that the presence of gender differences in secondary stroke prevention is still somewhat unknown, and is in need of further investigation.

A couple of studies have been conducted regarding the effect of socioeconomic status and ethnicity on secondary stroke prevention. One study found that some sociodemographically defined groups have different chances of receiving some components of care, but with no consistent pattern of inequality (12). This same study found some evidence, although weakly associated, that people of higher socioeconomic status were more likely to be admitted to

hospital and to a stroke unit (12). A second Canadian study found that stroke patients with lower socioeconomic status had increased mortality and decreased access to some healthcare resources (72). Considering the conflicting evidence regarding stroke care and socioeconomic status, it is again apparent that more research needs to be conducted in this area.

Finally, another study involved a literature review investigating the differences in stroke care between rural and urban areas in the United States (73). It was found that acute stroke management practices in rural areas are suboptimal, creating a health disparity between urban and rural stroke patients (73). Since this study only involved a review of the literature, it would be beneficial to conduct a full study on the differences in urban and rural stroke care.

2.3.2.1 Health Quality Council

The Health Quality Council (HQC) is an agency that measures and reports on quality of healthcare in Saskatchewan (10, 11). As part of this mandate, they have developed the Quality Insight program, which has recently (2008) produced the first edition of the Quality Insight Report (11). Within this document, there are sections on Post-Heart Attack Care and Diabetes Care, both of which provide examples for future measurement and reporting in stroke care.

In post-heart attack care, as with stroke care, secondary prevention using drug therapy is important (11). As part of their measurement, the HQC identified and reported on factors related to receiving medication. They found both age and gender to be contributing factors in determining whether or not the patients were dispensed the recommended medications (11).

In diabetes care, control of blood sugar and LDL-C levels is important to prevent complications (11). The HQC reported on factors related to control of blood sugar and cholesterol as outlined by blood tests. The factors found to be related to better or worse control were age, ethnicity, and gender (11).

CHAPTER 3: METHODOLOGY

3.1 Study Design

This study uses a multi-year cross-sectional design. It is based on record linkage and secondary analysis of de-identified administrative and clinical data.

3.2 Selection of Indicators

The indicators calculated in this study were selected directly from the Canadian Stroke Strategy Performance Measurement Manual (5). A brief description of how the measures were developed by the Canadian Stroke Strategy is as follows.

As previously stated, one of the goals of the Canadian Stroke Strategy is to ensure the integration of evidence-based best practices for stroke prevention and care into the Canadian health system (4). In working towards this objective, Canadian recommendations for stroke care were developed through an extensive process. This method involved review of stroke research, identification of key topics, synthesis of recommendations, and, finally, assessment by a national expert consensus panel (4). Following discussion and review at the panel meeting, final decisions were made for each recommendation, and the Canadian Best Practice Recommendations for Stroke Care (4) were published.

As a supplement to the Best Practice manual, and as a framework to measure the quality and consistency of stroke care, the Performance Measurement Manual was created (4, 5). This manual contains indicators that correspond to the Best Practice Recommendations, and provides detailed definitions for each of the performance measures (4). These indicators were selected based on specific criteria (5), and were developed to monitor the impact of implementing the Best Practice recommendations on the quality of patient care and/or patient outcomes (4).

In selecting the indicators to be calculated in this study, a process of literature and data review was undertaken. It was important to identify the indicators that were significant, yet under-researched in Saskatchewan, as well as possible to calculate with the resources available. Following some literature review, it was clear that the area of secondary stroke prevention lacked sufficient research in Saskatchewan, and in general. Therefore, the focus was on the indicators in the Performance Measurement Manual dealing with secondary stroke prevention. The measures in the manual were specific, but not in terms of operational definitions for each province. Thus, discussions took place at the HQC regarding the data available, and the feasibility of calculating the secondary stroke indicators. The final decision regarding the

indicators included in this study centered around which measures were most applicable for stroke prevention care in Saskatchewan, and had the necessary data and resources available.

3.2.1 Quality Indicator Measures and Definitions

Table 3.1 outlines the definitions of the performance measures as they appear in the Canadian Stroke Strategy Performance Measurement Manual (5). These along with the criteria outlined for identifying the stroke and TIA cohort, based on diagnosis codes in the hospital discharge abstract records, were used to identify the cohort subsets for the calculation of each indicator.

Table 3.1: Selected Performance Measures from the Canadian Stroke Strategy Performance Measurement Manual (5). Indicator numbering as per the Performance Measurement Manual.

Recommendation #	Recommended Performance Measures
2.2 Blood Pressure Management	vii. Proportion of stroke and TIA patients prescribed blood pressure lowering agents on discharge from acute care
2.3 Lipid Management	ii. Proportion of stroke patients prescribed lipid-lowering agents for secondary prevention of stroke – either at discharge from acute care, through a secondary prevention clinic, or by primary care iii. Proportion of stroke patients with an LDL-C between 1.8 – 2.5 mmol/L at 3 months following stroke event iv. Proportion of stroke patients with an LDL-C <2.0 mmol/L at 3 months following stroke event v. Proportion of stroke patients with an LDL-C >2.0 mmol/L at 3 months following stroke event
2.6 Antithrombotic Therapy in Atrial Fibrillation	i. Proportion of eligible stroke and TIA patients with atrial fibrillation prescribed anticoagulent therapy on discharge from acute care v. Proportion of patients on warfarin with INR in therapeutic range at 3 months, 6 months, and 1 year following index stroke event

3.3 Data

3.3.1 Data Sources and Acquisition

This study was based on data from two sources: Saskatchewan Health Administrative Databases, and Laboratory Data from the Saskatoon Regional Health Authority and Regina Qu'Appelle Regional Health Authority laboratory test results databases.

3.3.1.1 Saskatchewan Health Administrative Databases

In Saskatchewan, there are thirteen separate regional health authorities. Health services are provided to the residents of the province through a publicly funded, universal health system (74). This universal health care program has allowed for the accumulation of a large amount of health care information in computerized databases over a number of years (74). These databases have been recognized as a resource for drug utilizations review, pharmacoepidemiology, and health economics (74), and were utilized in calculating the indicators for this study. A list of Saskatchewan Health Administrative Databases used in the study is available in Appendix A.

The de-identified administrative health data utilized was made available to the HQC through a standing data sharing agreement between the Ministry of Health and HQC. Data from seven Ministry of Health administrative databases were abstracted and electronically linked with encrypted identification numbers at the individual person level. See Appendix A for a table listing the databases and the key variables abstracted from each dataset. These datasets were available via a secure virtual private network (VPN) connection to a data warehouse located in the Ministry of Health. The data sharing agreement stipulated which data fields HQC had access to in each database, expectations for protection of patient privacy in use and storage of data, as well as in any reporting based on the data.

3.3.1.2 Primary Source Laboratory Data

In contrast to the data for the drug therapy indicators, the LDL-C and INR test indicators required laboratory data. This data was obtained from two regional health authorities in Saskatchewan. The regions included were the Saskatoon Regional Health Authority (SRHA) and the Regina Qu'Appelle Regional Health Authority (RQRHA). The reason for including only these regions is because the tests of interest were done in a large number of laboratories across the province, and a central repository for all of the results does not yet exist. The SRHA and

RQRHA were chosen because they are the most populous areas of the province, and because there were existing mechanisms for sharing of laboratory data with the HQC.

To acquire the necessary laboratory data for this study, data sharing agreements were established between HQC and each of regional health authorities contributing data to the study. For both the SRHA and RQRHA, Master Data Sharing Agreements were already in place between the region and the HQC, and, in accordance with the agreements, a Data Sharing Schedule was appended to those agreements pertaining to data sharing for this particular study. These Data Sharing Schedules stipulated which data was requested from the region and expectations for de-identification, data protection, as well as any reporting based on the data.

3.3.1.3 Drug Information Acquisition

The original drug list obtained for use in this study was acquired from Dr. Moira Kapral, an internal medicine physician and stroke researcher in Ontario. This list had been previously used to calculate similar drug indicators for the Ontario Stroke Strategy and was based on findings in the literature, as well as clinical best practices regarding stroke care.

At the HQC, there is a process followed in creating drug lists for indicator calculations. Upon receiving the list from Dr. Kapral, three separate drug lists were created for each of the indicator calculations in the study (i.e. antihypertensives, antilipidemics, anticoagulants) using previously developed SAS macros. The drug identification numbers (DINs) for medications belonging to the drug generic names on the list were found by searching the Ministry of Health "All DIN" file by generic name of the drug. These numbers are unique to each specific drug, formulation, and packaging. Records indicating dispensing of the medications of interest were identified by searching the Prescription Drug Plan Historical Claims database (Appendix A) for these DINs within the populations of interest for the indicators. The three drug lists were then sent to the HQC's pharmacotherapy consultant (a professor in the College of Pharmacy and Nutrition at the University of Saskatchewan) for review.

The consultant assessed the drug lists to ensure they were complete, accurate, and listed the relevant drugs that would be available in Saskatchewan. As part of the review, the consultant searched the literature on medication for the areas of interest related to secondary stroke prevention. It was verified, based on the literature and the consultant's clinical opinion, that no major drug categories were missing from each of the drug lists. If there was a drug missing on the list, the consultant notified the HQC, and the HQC contacted Dr. Kapral for a clinical

opinion. Following this discussion, the missing drug was either added or left off the list. When the assessment of the drug lists was complete, the consultant forwarded them to the HQC.

3.4 Study Population

3.4.1 Definitions Used for Study Population Criteria

Hospitalization
Inclusion in the Hospital Discharge Abstract Database (DAD) was considered as the indicator for hospitalization.

Registered Indian Status
Refers to those persons who reported they were registered under the Indian Act of Canada.

Death
The date of death was determined from four data sources (Person Registry System, Vital Statistics, Institutional Care Home File, and Hospital Discharge Abstract Database), each of which captured information on date of death. However, there may have been errors in the coding of deaths in some of these databases and disagreements between the data in them concerning individuals. For example, HQC has found that historically, about 5% of cases coded as death in the discharge disposition field of the Hospital Discharge Abstract Database are incorrectly coded as deaths.

In general the date of death found in these various data sources was in agreement, but where differences existed, an iterative algorithm of rules and hand checking was conducted to select the date that was most likely to be correct. Vital statistics is commonly used as the source of death information in studies. However, the vital statistics file HQC had access to did not contain out-of-province deaths and this information was obtained using the PRS file. As the HQC used an iterative algorithm of rules and hand checking, they deleted cases from the vital statistics file because of errors discovered when verifying with the other data files, including duplicate cases. They also checked the physician billing and prescription drug dispensing data sources to verify deaths. If there were physician billings after one week and/or drug dispensing activity after six months beyond the putative date of death, then the death date was considered to be in error and the person was considered to be still alive. In the resulting HQC verified death

file 97% of the records had the same date of death as that recorded for the individuals in the vital statistics file; the remaining 3% of records were derived from the other data sources.

Provincial Health Insurance Coverage
The HQC had multiple historical records based on coverage and expiry dates of the health card (and thus coverage by Saskatchewan health insurance) which allowed for the determination of how many days an individual was covered by the provincial health plan within a particular assessment period. The length of time an individual had to have coverage was dependent on the indicator being calculated.

Episode of Care
An episode of acute care may have involved stays in more than one hospital if a patient was transferred among hospitals. If a patient was discharged from one hospital and admitted to another within the same day or the next calendar day, the transfer was considered to be part of the same episode of care (EOC). In other words, an EOC started on the date of admission to the first hospital, and extended to the discharge date of the last hospital in which a patient was treated. The primary diagnosis for the first episode in the EOC had to be stroke/TIA, but any ensuing episodes could have been for other causes (i.e. rehab, follow-up procedures). This method allowed for the capture of the entire EOC, and thus the most appropriate final discharge date.

3.4.2 Stroke and TIA Patient Cohort

The target population was all hospitalization episodes for Saskatchewan residents due to a stroke or TIA between April 1, 2001 – March 31, 2008. This population was identified using the Hospital Discharge Abstract Database (DAD), which is part of the Saskatchewan Health administrative databases presented in Appendix A. The International Classification of Diseases, version 10-CA (ICD-10-CA) codes shown in Table 3.2 (5) were used to define and identify the stroke and TIA cases.

Table 3.2: Stroke Diagnostic Codes

Stroke Subcategory	ICD-10-CA codes
Acute stroke	I60 (exclude I60.8) I61 I63 (exclude I63.6) I64 I67.6 H34.1
Ischemic stroke (includes acute but ill-defined cerebrovascular)	I63 (exclude I63.6) I64 H34.1
Subarachnoid hemorrhage	I60
Intracerebral hemorrhage	I61
Transient ischemic attack	G45 (exclude G45.4) H34.0

To be included in the study, the identified stroke and TIA cases had to meet a number of criteria. The inclusion and exclusion criteria, as well as the rationale, are presented in Table 3.3.

Table 3.3: Stroke and TIA Patient Cohort Criteria and Rationale

Stroke and TIA Patient Cohort		Rationale
Inclusion Criteria	Primary diagnosis (most responsible diagnosis) of stroke or TIA on hospital discharge record.	The purpose of the study is to gain an understanding of condition management with drugs in secondary stroke prevention. In order to do so, patients who have experienced a stroke or TIA need to be identified as accurately as possible.
Exclusion Criteria	Individuals aged < 18 years on the date of the stroke or TIA;	By setting the minimum age at 18, most of the stroke events will be captured. Also, this is the age of adulthood in Canada.
	All out-of-province hospitalizations;	The study involves stroke care in Saskatchewan, and thus residents who were hospitalized elsewhere need to be excluded.
	Individuals without valid Saskatchewan Health Insurance;	Must be covered for time period of interest (last discharge date to service

		date). Using the "service date" means that the reporting is based on the assessment date for a service (in this case, assessment for drugs). If no coverage, the person may have died or moved out of province. In either case, they should not be included in the cohort.
	Individuals with no information on sex and date of birth;	Such information is necessary for proper data analysis, and thus where information is missing the individuals need to be excluded.
	Individuals identified as Registered Indians;	Individuals with Registered Indian status were identified and excluded since their prescription drugs are covered by the federal government and are not (consistently) captured in the provincial Prescription Drug Plan Historical Claims dataset.
	Individuals with no information available in the Prescription Drug Plan Historical Claims Database;	Because the purpose of the study is to examine drug dispensing patterns, residents without drug data need to be excluded (presumably because their prescription drugs are covered federally).
	Individuals who died in hospital of their stroke event.	The purpose of the study is to examine secondary stroke care, and this is nonexistent in individuals who did not survive their stroke event.

Appendix B contains the complete Researcher Documentation (see Table 1.1 for definition) as used in all HQC analyses. This document was created based on HQC methodology and documentation format, but the content was newly created for this study; there was no pre-existing stroke indicator methodology available at the HQC. Refer to Appendix B for a thorough understanding of the creation of the Stroke and TIA Patient Cohort.

3.5 Technical Definitions

The following variables were utilized in this study. The definitions given here are taken from the HQC Quality Insight Technical Appendix (75) except for definitions necessary for the quality of care indicators developed in this study.

3.5.1 Correlates Used in Analysis

Sex

The indication of 'male' or 'female' in the Person Registry System (PRS) was used as the indicator for sex.

Age

Birth month and birth year were supplied in the version of the PRS database accessed by the HQC. The 15th day of the month was assigned as the birth day for purposes of calculating age. The reference date used for calculating age (that is, the date from which days were counted back to the birth date) was the date of admission into the hospital for a stroke or TIA.

Regional Health Authority (RHA)

In the version of the Person Registry System accessed by the HQC, there were multiple historical records per individual that identified their RHA(s) of residence over time. For analysis of the indicators by RHA within a specified period of time, individuals were assigned to the RHA in which they resided for the greatest number of days during that period. If RHA information was missing on this date, the search was extended to plus and minus six months from this date and RHA was assigned where the person lived most in this period. If RHA in this period could not be found, RHA information was treated as missing.

Since individuals in Saskatchewan may have been hospitalized in a different RHA from which they live, it was also important to assign RHA to individuals according to hospital. Thus, the individuals were assigned a second RHA according to the RHA of their last hospital of discharge. Again, if no hospital RHA was found, the RHA information was treated as missing.

Urban/Non-Urban

To assign the urban or non-urban place of residence classification to individual PRS records, the Health Information Solutions Centre (HISC) at the Ministry of Health linked postal codes to Statistics Canada census geographic areas. Individuals that resided, or institutions located, in a

census metropolitan area or census agglomeration as defined by Statistics Canada were considered as urban; otherwise they were classified as non-urban.

Income Quintile

To assign income quintiles to individual PRS records, the HISC at the Ministry of Health linked postal codes to census geographical data at the level of the dissemination area (DA) which is the lowest level of geography that Statistics Canada disseminates census data. In doing so the postal code conversion file was linked using the Postal Code Conversion File Plus (PCCF+) software. Income quintiles were based on average 2001 Census household income, with adjustment for household size for the linked census DAs. In the file received by HQC, 14% of individuals had missing income quintile (INCQTL) information due to suppressed census information for DAs with population less than 250. The HQC was able to calculate imputed values of INCQTL for most cases with missing INCQTL values, such that in the end there were only about 0.5% of individuals province-wide with no value for INCQTL.

Hospital Category

Hospital categories were used as classification variables. The list of hospitals and their categories were obtained from the Ministry of Health. Hospitals were categorized into the following types: Provincial hospitals (of which there are 6 in the province), Regional (7), District (9), Community (109), Northern (4). The full listing is available in Appendix C. Due to the nature of the indicators, a hospital category was assigned to each patient based their last hospital of discharge.

Previously On Drugs

Taking into consideration the type of medications being investigated in this study, it was possible that patients were taking the drugs of interest before their stroke event. It was therefore important to identify these patients for the analysis. Using the pharmaceutical dispensing data, patients were identified and flagged if they filled a prescription for the medication of interest prior to their admission date.

Length of Stay

Length of stay was the amount of time a patient was admitted to hospital for their stroke event. A patient's length of stay was determined by counting the number of days they were hospitalized from their first admission date for stroke, to their final discharge date. For example, if a person

was admitted to hospital on November 1, 2002, and discharged on November 15, 2002, their length of stay was 14 days.

Fiscal Year

Fiscal year in this study implied that the service date for a patient fell between April 1st of one year, and March 31st of the next year (2001/02-2007/08). For example, if a person was discharged from hospital on May 1st, 2005, their 3-day service date would be May 4th, 2005. Therefore, this patient's fiscal year for all 3-day indicators was 2005/06. Fiscal years were assigned differently for the 3-day and 90-day indicators, meaning that a patient might be in one fiscal year at 3 days, and the next fiscal year at 90 days.

3.6 Drug Indicators

The indicators included within this section are numbers 2.2 vii., 2.3 ii., and 2.6 i. from Table 3.1 as they each involved drug care for secondary stroke prevention. Following methodological decisions pertaining to adapting the definitions to available data in Saskatchewan, a list of the revised stroke/TIA quality indicators for medications was created, and is presented in full form in Appendix D. Appendix B contains the complete Researcher Documentation for the development of the 3-day and 90-day denominators and numerators for the drug indicators (see Table 1.1 for definitions).

3.6.1 Medication-Related Process of Care Indicator Denominators

For each of the medication-related indicators, the assessment for drugs was to take place after "discharge from acute care" (see Table 3.1). A decision was made to make an assessment for medication at both 3 and 90 days post-discharge. The reason for doing so was because of the difference in what was being measured. The calculation made at the 3-day period assessed the hospital-based secondary stroke prevention processes of care. If an individual was dispensed a medication within 3 days of discharge, it was most likely that the prescription was provided by a hospital-based physician, and therefore reflected hospital-based processes for initiating secondary stroke prevention. On the other hand, the calculation made at the 90th day post-discharge was an assessment of the ongoing attention to secondary stroke prevention which reflected processes involving the primary care/community based physician. If an individual was taking medication at the 90th day following discharge, it can in part be attributed to the primary

care physician ensuring the patient has had their prescription renewed/updated and understands the importance of the medication.

In developing the separate denominators for the drug indicators, the general cohort criteria were used as well as additional inclusion and exclusion criteria as shown in Table 3.4

.

Table 3.4: Medication-Related Indicator Denominators Inclusion and Exclusion Criteria

Medication Denominators	Inclusion Criteria	Exclusion Criteria
3-Day Drug Denominator	• Inclusion in the Stroke and TIA Patient Cohort; • Individuals with Saskatchewan Health Insurance coverage from the date of hospital discharge, through 3 days post discharge.	• Individuals who died before 3 days post-discharge; • Individuals whose fiscal year at 3 days post-discharge falls into 2008/09, which is outside of the study period. See Appendix B for further explanation and rationale.
90-Day Drug Denominator	• Inclusion in the Stroke and TIA Patient Cohort; • Individuals with Saskatchewan Health Insurance coverage from the date of hospital discharge through to 15 days before the 90th day post-discharge (i.e. through the 75th day after discharge). See #3c in Appendix B for rationale.	• Individuals who died before 90 days post-discharge; • Individuals whose fiscal year at 90 days post-discharge falls into 2008/09, which is outside of the study period. See Appendix B for further explanation and rationale.
3-Day Atrial Fibrillation Drug Denominator	• Inclusion in the 3-Day Drug Denominator; • Diagnosis of atrial fibrillation on hospital discharge record.	
90-Day Atrial Fibrillation Drug Denominator	• Inclusion in the 90-Day Drug Denominator; • Diagnosis of atrial fibrillation on hospital discharge record.	

3.6.1.1 Drug Indicator Denominator Development

The development of the drug indicator denominators (i.e. 3-day, 90-day, atrial fibrillation) are outlined in the examples contained in Figures 3.1, 3.2, and 3.3 below.

Figure 3.1: Development of the 3-day stroke/TIA patient cohort based on the date of admission

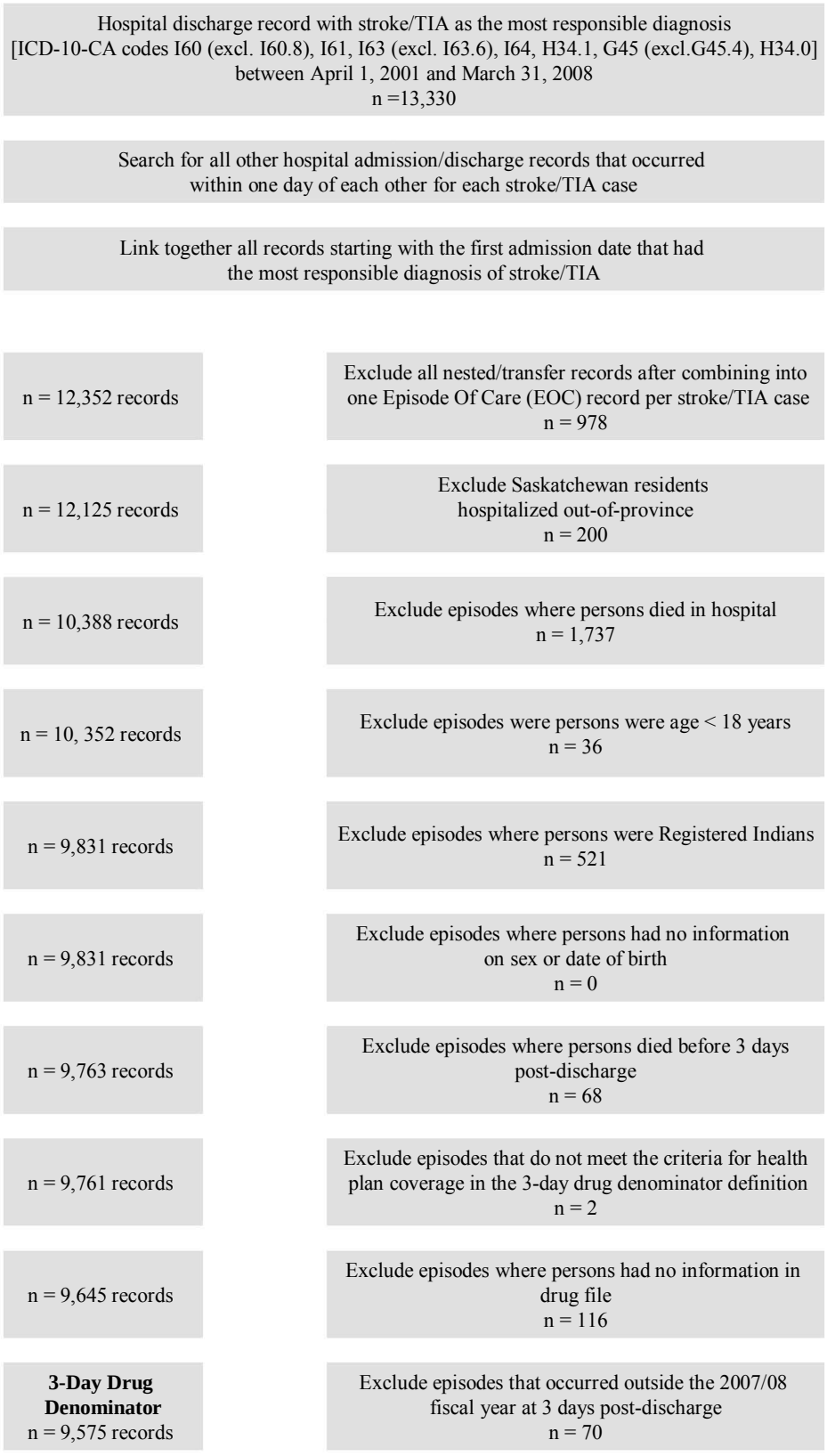


Figure 3.2: Development of the 90-day stroke/TIA patient cohort based on the date of admission

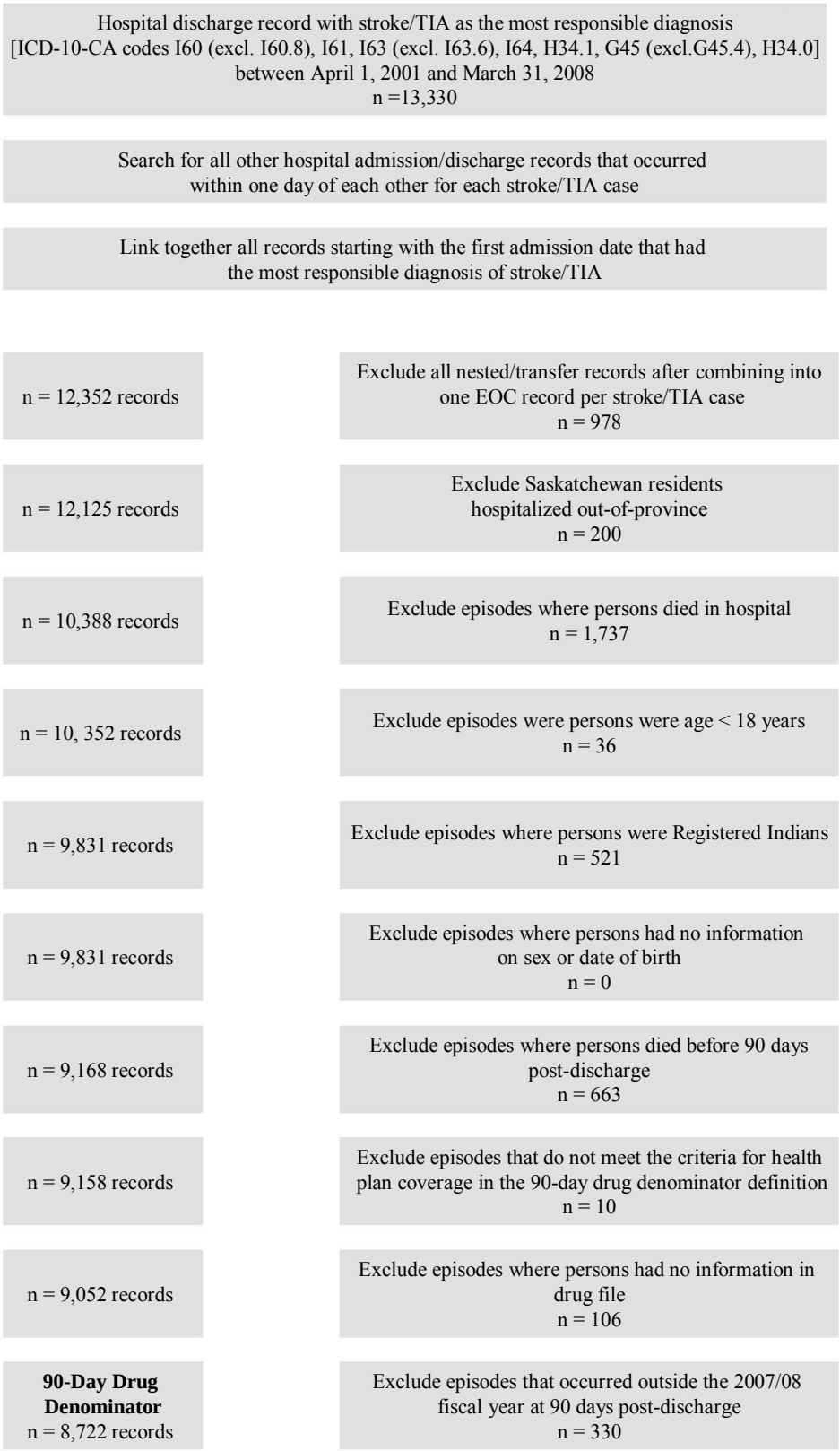
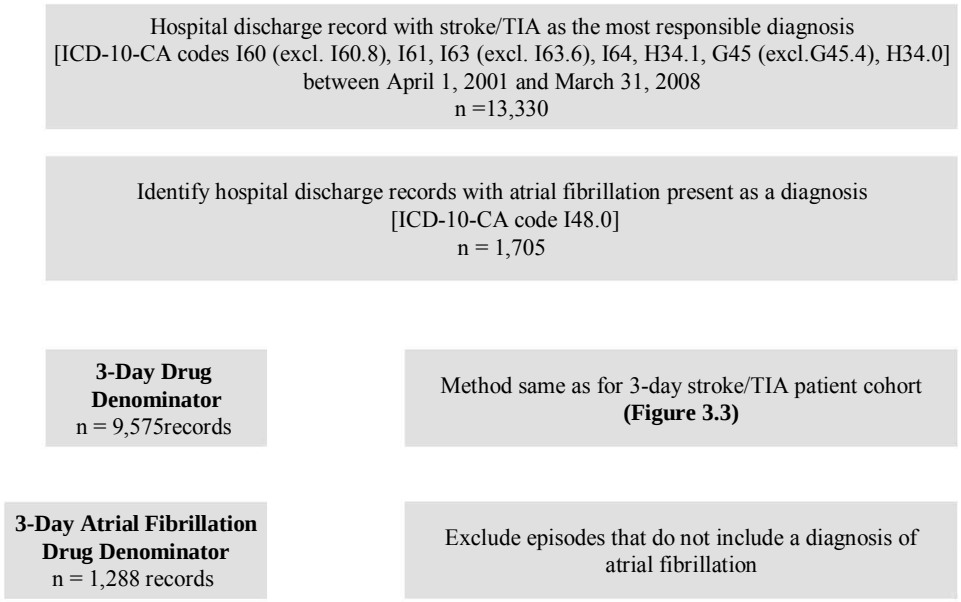


Figure 3.3: Development of the 3-day stroke/TIA atrial fibrillation patient cohort based on the date of admission



3.6.2 Drug Indicator Numerators

3.6.2.1 Drug Use

Each of the drug indicators was based on the ascertainment of whether the stroke/TIA patients had been dispensed sufficient supply of the drug of interest to be able to be taking it on a given day (3rd or 90th) after discharge from hospital. The HQC had previously developed methodology for estimating sufficient drug supply, and the same methodology was used for this project. For complete explanation of methodology, refer to the excerpts from the HQC Quality Insight Technical Appendix (75) attached as Appendix E and Appendix F.

Essentially, a calculation was made as to whether the patient would have sufficient drug supply from their most recent dispensing date (pharmaceutical dispensing data) to last until the date of interest (3-day, 90-day). This was done by approximating the number of pills taken daily by the patient (based on the amount of drug dispensed and previous dispensing dates), and their most recent prescription date. If the time from the last dispensing date to the, for example, 90th day post-discharge was fewer than the number of days of available drug, then the patient was said to be "on" the particular medication at the 90th day post-discharge. Conversely, if the available drug amount indicated that the patient ran out of pills before the 90th day post-

discharge, then the patient was said to be "not on" the particular medication at the 90th day post-discharge.

If there was no previous dispensing data for the patient (no information on the approximate number of pills taken per day), the minimum pill frequency was set at 1 pill per day. Even though 1 pill per day may not be enough to be considered a "therapeutic dose" for all drugs, there are potential reasons a patient may be on a lower dose (i.e. doctor adjusting a patient's drug regimen). Thus, it seemed 1 pill per day was a reasonable standard.

Drug Numerators Inclusion Criteria

- Inclusion in the appropriate denominator;
- "On" the medication of interest according to the outlined methodology.

3.6.2.2 Drug Indicator Categories

For each of the three drug categories of interest in this project (antihypertensives, antilipidemics, anticoagulants), there was one major drug class in each that was calculated separately (statin, angiotensin-converting enzyme inhibitors (ACEI), warfarin). This was done because the information on these drug classes was of major importance for clinical applicability.

Antihypertensive Drug Categories

- All antihypertensive medications
- Only ACEI medications

Antilipidemic Drug Categories

- All antilipidemic medications
- Only statin medications

Anticoagulant Drug Categories

- All anticoagulant medications
- Only warfarin medications

3.7 Indicators Using Laboratory Data

The indicators included within this section are numbers 2.3 iii., iv., v., and 2.6 v. from Table 3.1 as they each involved laboratory tests that are important in secondary stroke prevention. Following methodological decisions, a list of the revised stroke/TIA quality indicators for laboratory tests was created, and is presented in Appendix G. Appendix B contains the complete Researcher Documentation (including criteria and rationale) for the

development of the denominators and numerators for the laboratory indicators (see Table 1.1 for definitions).

An important note is that laboratory data could only be acquired for the Saskatoon RHA and the Regina Qu'Appelle RHA. It is because of this that only people who live in these RHAs were included in these indicator calculations.

3.7.1 Low Density Lipoprotein Cholesterol (LDL-C) Indicators

3.7.1.1 LDL Indicator Denominators

For the LDL indicators, the assessment for LDL-C tests was to take place at "3-months post-stroke". To ensure there was adequate coverage of the tests given around the 3-month period, the timeframe was extended to 2-4 months.

Following the initial identification of the individuals who met the criteria, it became apparent that the number of people was too small for the indicator calculations. Thus, the percentage of people given an LDL test at 3 months was calculated using the 2-4 month criteria, but the timeframe was expanded to 2-12 months for the actual indicator calculations. See Table 3.5 for all denominator inclusion and exclusion criteria.

Table 3.5: LDL-C Indicator Denominators Inclusion and Exclusion Criteria

LDL Denominators	Inclusion Criteria	Exclusion Criteria
LDL 2-4 Month Denominator	• Inclusion in the 90-Day Drug Denominator; • Individuals who live in the Saskatoon RHA or the Regina Qu'Appelle RHA.	
LDL 2-12 Month Denominator	• Same as LDL 2-4 Month Denominator	
LDL Test Result Indicator Denominator	• Inclusion in the LDL 2-12 month denominator; • Individuals who had an LDL-C test 2-12 months following their stroke event.	• Individuals with an LDL test record with a missing result; • If there was more than one test result within the timeframe, only the most recent was used – all others were deleted.

3.7.1.2 LDL Indicator Numerators

There were five separate indicators involving the LDL-C test. Each indicator numerator involved different inclusion and exclusion criteria as shown in Table 3.6.

Table 3.6: LDL-C Indicator Numerators Inclusion and Exclusion Criteria

LDL Numerators	Inclusion Criteria	Exclusion Criteria
LDL Test at 2-4 Months	• Inclusion in the LDL 2-4 month denominator; • Individuals with an available LDL test result 2-4 months post-discharge.	• Individuals with an LDL test record with a missing result; • If there was more than one test result within the timeframe, only the most recent was used – all others were deleted.
LDL Test at 2-12 Months	• Fulfillment of the criteria, and inclusion in the LDL 2-12 month denominator; • Individuals with an available LDL test result 2-12 months post-discharge.	• Same as LDL Test at 2-4 Months.
LDL Result 1.8-2.5	• Inclusion in the LDL test result indicator denominator; • Individuals with an LDL test result 1.8-2.5.	
LDL Result <2.0	• Inclusion in the LDL test result indicator denominator; • Individuals with an LDL test result less than 2.0.	
LDL Result >2.0	• Inclusion in the LDL test result indicator denominator; • Individuals with an LDL test result greater than 2.0.	

3.7.2 INR Indicators

3.7.2.1 INR Indicator Denominators

For the INR indicator, the main criterion for inclusion was that the individual had to be taking warfarin. In developing the denominators for these indicators, this criterion was used as well as additional inclusion and exclusion criteria as shown in Table 3.7.

Table 3.7: INR Indicator Denominators Inclusion and Exclusion Criteria

INR Denominators	Inclusion Criteria	Exclusion Criteria
INR Test Denominator	• Inclusion in the 90-Day Drug Denominator; • Individuals who live in the Saskatoon RHA or the Regina Qu'Appelle RHA; • Individuals who were "On" warfarin (according to the drug indicator criteria) at either 3-days or 90-days post-discharge.	
INR 2-4 Month Denominator	• Inclusion in the INR test Denominator; • Individuals who had an INR test 2-4 months following their stroke event.	• Individuals with an INR test record with a missing result; • If there was more than one test result within the timeframe, only the most recent was used – all others were deleted.
INR 5-7 Month Denominator	• Inclusion in the INR Test Denominator; • Individuals who had an INR test 5-7 months following their stroke event.	• Same as INR 2-4 Month Denominator.
INR 11-13 Month Denominator	• Inclusion in the INR Test Denominator; • Individuals who had an INR test 11-13 months following their stroke event.	• Same as INR 2-4 Month Denominator.

3.7.2.2 INR Indicator Numerators

For the INR indicators, the assessment for INR tests was to take place at 3 months, 6 months, and 12 months post-stroke. To ensure there was adequate coverage of the tests given around these time periods, the timeframe for each was extended by one month (i.e. for 3 months, the timeframe was 2-4 months).

The numerators called for inclusion of individuals who had an INR test result "in therapeutic range". According to the Best Practice Guidelines (4), the target INR for patients on warfarin should be 2.5, range 2.0-3.0. Thus, this range was used for the indicators. See Table 3.8 for inclusion and exclusion criteria for all INR numerators.

Table 3.8: INR Indicator Numerators Inclusion and Exclusion Criteria

INR Numerators	Inclusion Criteria	Exclusion Criteria
INR Test at 2-12 Months	• Inclusion in the INR test denominator; • Individuals with an INR test result 2-12 months post-discharge.	• Individuals with an INR test record with a missing result; • If there was more than one test result within the timeframe, only the most recent was used – all others were deleted.
INR 2.0-3.0 at 2-4 Months	• Inclusion in the INR 2-4 month denominator; • Individuals with an INR test result 2.0-3.0.	
INR 2.0-3.0 at 5-7 Months	• Inclusion in the INR 5-7 month denominator; • Individuals with an INR test result 2.0-3.0.	
INR 2.0-3.0 at 11-13 Months	• Inclusion in the INR 11-13 month denominator; • Individuals with an INR test result 2.0-3.0.	

3.8 Outcome Variables and Correlates

Table 3.9 describes the outcome variables used in logistic regression. Table 3.10 describes the correlates used in logistic regression. Cut points for categorical variables were selected based on their clinical significance and data availability.

Table 3.9: Description of the Outcome Variables

Outcome Variable	Description	Variable Coding
Allhypflag90 (Antihypertensives at 90 Days)	Dichotomous variable; on or not on antihypertensives (including ACEIs) at 90 days post-discharge.	0 = "not on" antihypertensives 1 = "on" antihypertensives
Lipstatflag90 (Antilipidemics at 90 Days)	Dichotomous variable; on or not on antilipidemics (including statins) at 90 days post-discharge.	0 = "not on" antilipidemics 1 = "on" antilipidemics
Allcoflag90 (Anticoagulants at 90 Days)	Dichotomous variable; on or not on anticoagulants (including warfarin) at 90 days post-discharge.	0 = "not on" anticoagulants 1 = "on" anticoagulants
Flag10 (LDL) (LDL-C Test, 2-12 Months)	Dichotomous variable; given or not given an LDL-C test between 2-12 months post-discharge.	0 = not given a test 1 = given at least one test
Testflag (INR) (INR Test, 2-12 Months)	Dichotomous variable: Given or not given an INR test between 2-12 months post-discharge.	0 = not given a test 1 = given at least one test

Table 3.10: Description of the Correlates

Correlates	Description	Variable Coding
Sex	Dichotomous variable; male or female.	0 = Male (ref) 1 = Female
Age	Categorical variable with 3 levels that indicate the age group of the person (in years) at the time of their stroke/TIA.	0 = 18-74 1 = 75-84 (ref) 2 = 85+
RHA of Residence	Categorical variable with 11 levels that indicate the RHA of residence of the person during the time	1 = "01 Sun Country" 2 = "02 Five Hills" 3 = "03 Cypress" 4 = "04 Regina Qu'Appelle"

	period of interest (i.e. 90-day).	5 = "05 Sunrise" 6 = "06 Saskatoon" (ref) 7 = "07 Heartland" 8 = "08 Kelsey Trail" 9 = "09 Prince Albert Parkland" 10 = "10 Prairie North" 11-13 = "15 Northern Saskatchewan"
Income Quintile	Categorical variable with 5 levels that indicate the person's income quintile.	1 = "Lowest" (ref) 2 3 4 5 = "Highest"
Urban/Non-Urban	Dichotomous variable; urban or non-urban.	0 = "Urban" (ref) 1 = "Non-Urban"
Hospital Category	Categorical variable with 4 levels indicating the hospital category of the person's hospital of discharge.	1 = "Provincial" (ref) 2 = "Regional" 3 = "District" 4 or 5 = "Community and Northern"
Length of Stay	Count variable that indicates the total length of stay in hospital for each stroke/TIA episode.	0 = 0-10 days (ref) 1 = 11-30 days 2 = 31+ days
Multiple Stroke/TIA	Dichotomous variable that indicates if the stroke/TIA episode is a multiple. "Multiple" meaning that a patient had another stroke/TIA within two years of their first episode. See Appendix B for further description and rationale.	0 = Not a multiple stroke/TIA (ref) 1 = Multiple stroke/TIA
Previously on Drugs	Dichotomous variable that indicates if the individual was on a specific drug before their stroke/TIA event.	0 = Not previously on drug (ref) 1 = Previously on drug

3.9 Ethics Approval and Privacy

This study was approved by the University of Saskatchewan Biomedical Research Ethics Board (Bio-REB #09-105). The study was also approved by the Regina Qu'Appelle Health Region (RQHR Project REB #09-34).

Considering this study used secondary data that has been de-identified, there were not many anticipated ethical issues. One potential problem may have been re-identification of patients through data matching. The mitigation to this is that only encrypted and transformed identifiers were used in the data, and results were not reported based on fewer than 6 individuals. A confidentiality agreement was signed at the HQC, and any attempt to re-identify would have resulted in denial of further access to the data.

3.10 Data Analysis

3.10.1 Question One: Indicators of the Quality of Secondary Stroke Prevention

Descriptive measures were the primary analytic strategy for this question. Frequencies for each of the correlates (except Previously on Drugs) seen in Table 3.10 were calculated to define and describe the general stroke/TIA cohort.

Each indicator was calculated using all stroke/TIA, as well as for hemorrhagic stroke. Treatment for stroke may vary by the type of stroke an individual has, and therefore it was important to calculate the overall indicators separately for hemorrhagic stroke. Due to the small percentage of people who have a hemorrhagic stroke, this indicator was calculated for the entire province only (not for separate RHAs).

3.10.1.1 Medication-Related Process of Care Indicators

For each specific part of the question (each drug indicator), subsets of the cohort were identified according to the numerator and denominator descriptions outlined in Section 3.6.1 and 3.6.2. Following the selection of the cohort subsets, the drug indicators were calculated according to fiscal year at service date (3 or 90 days post-discharge).

3.10.1.2 LDL Intermediate Outcome Indicators

The cohort subset was identified according to the numerator and denominator descriptions outlined in Section 3.7.1. Individuals were included in reporting of the indicator for a particular fiscal year according to the date at 3 months post-discharge.

3.10.1.3 INR Intermediate Outcome Indicators

The cohort subset was identified according to the numerator and denominator descriptions outlined in Section 3.7.2. The indicator was calculated according to the 3, 6 and 12 month timeframes.

3.10.2 Question Two: Correlates Associated with Receiving Secondary Stroke Prevention

Logistic regression was the primary analytic strategy. For each of the outcome indicator variables listed in Table 3.9, logistic regression was used to identify the factors related to receiving the secondary stroke prevention described by the outcome indicator.

Univariate analysis was first performed for each of the correlates listed in Table 3.10. The age and length of stay variables were tested for linearity using a macro available at the HQC. The macro plotted a graph, and if the points were in a straight line, the variable was said to be linear. If the points were not straight, the variable was said to be non-linear and had to be made into a categorical variable. Both age and length of stay were found to be non-linear, and thus were made into categorical variables. Therefore, all variables used in the model were categorical in nature. Any variable whose univariate test had a p-value<0.25 was kept as a candidate for the multivariable model along with all variables of known clinical importance.

All of the variables identified from univariate analysis were then fitted into a multivariable model. Variables that were statistically significant (p-value<0.05) and/or clinically important (i.e. sex, age) were retained in the model as main effects. If any one of the categories for the variables achieved statistical significance the entire variable was retained in the model.

Once main effects were established for each of the five models, the interaction term sex*age was tested for statistical significance. This interaction term was selected for testing because it is clinically very important to identify differences in care by both sex and age. During data exploration, other interaction terms were considered for regression analysis, but they were either clinically not meaningful or not easily interpretable. Further, there was no literature reporting other plausible interaction terms, and therefore no others were tested in the logistic model. The interaction term sex*age was retained in the final model if the likelihood ratio test value was statistically significant at the alpha is less than 0.05 level. Interaction terms were also treated as categorical variables.

After all main effects and interaction terms had been tested for statistical significance, a final model was run that only included the statistically significant variables. To assess the fit of the model, the Hosmer and Lemeshow Goodness-of-Fit test was performed on each of the models. The strength of the association (odds ratio) for each of the retained variables were subsequently calculated.

3.10.3 Question Three: Geographical Variation in Secondary Stroke Prevention by Saskatchewan Regional Health Authority Areas

A contrast model in logistic regression was utilized to compare the Regional Health Authority (RHA) areas. Basically, each RHA was compared to a group comprising all other RHAs in the province for each of the indicators. The rationale for using this type of comparison group is that it gives proper weight to the distribution of the province's population, which is not the case when using a provincial average. If there was variation in an RHA, the contrast showed statistical significance.

When calculating the contrasts, there were occasions when a "0 cell" (no individuals in the numerator) or "100% cell" (same number of individuals in the numerator and denominator) appeared in one or more of the fiscal years. When this occurred, one of two methods was used to account for these problems:

1) If there were <6 people in the denominator, the RHA was removed from the contrast model analysis.
2) If there were >6 people in the denominator, a "work around" process developed at the HQC was utilized to solve the problem. Very basically, a series of statistical calculations were made including the problem RHA within larger RHAs to properly run the contrast model.

CHAPTER 4: RESULTS

4.1 Description of the Study Population

To acquire an understanding of the population hospitalized in Saskatchewan for stroke/TIA, descriptive statistics by stroke etiology and correlates used in the analysis were calculated and are presented in Tables 4.1 and 4.2 respectively. All variables are categorical, and the frequency and the percentage are presented for each of the categories.

There were many more ischemic strokes than hemorrhagic strokes (89.1% vs. 10.8%; Table 4.1), which is roughly consistent with the expected 80% vs. 20% split described in the literature (1). The majority of people in the "stroke cohort" (i.e., the study population) experienced a cerebrovascular accident event that was labeled as stroke (66.8%) by the attending acute care physicians, but TIA events accounted for about one-third (33.3%) of the total study population. Only 13.5% of the people who experienced a stroke or TIA also had a diagnosis of atrial fibrillation. The total number of people included in the study population was 9,645.

Table 4.1: Description of stroke etiology for the Stroke/TIA Patient Cohort

Episode Type	Frequency	Percentage of Stroke	Percentage of Total Stroke/TIA
Stroke	6438	100%	66.8%
• Ischemic Stroke	5741	89.1%	
• Hemorrhagic Stroke	695	10.8%	
TIA	3207		33.3%
Stroke/TIA cases with Atrial Fibrillation	1302		13.5%
Total Stroke/TIA	9645		100%

Table 4.2 indicates that the number of males and females in the study population was almost even, as was the distribution of people living in an urban or non-urban setting. The majority of stroke/TIA events occurred in individuals over the age of 65 (82.5%). The largest number of stroke/TIA episodes took place in the 75-84 age-group (37.3%), and the fewest took place in the 18-49 age-group (4.8%). As anticipated, the largest number of people who had a stroke/TIA lived in the Saskatoon (25.0%) or Regina Qu'Appelle (21.2%) health regions which are the most populous in the province. The majority of stroke/TIA episodes were hospitalized in a provincial hospital (47.4%), while 19.1% were in a regional hospital, 12.0% were in a district hospital, and 21.5% were in a community or northern hospital. For 60.9% of the patients, the hospital stay was1-10 days, while 23.6% stayed for 11-30 days, and 15.5% had lengths of stay

greater than 31 days. In this study population, 93.8% of the episodes were "first strokes" while 6.2% were "multiple strokes" (i.e. second, third, fourth, etc. strokes).

Table 4.2: Distribution of Correlates in the Study Cohort

Correlates	Category	Frequency	Percentage (%)
Sex	Male	4782	49.6%
	Female	4863	50.4%
Age	18-49	465	4.8%
	50-64	1225	12.7%
	65-74	2025	21.0%
	75-84	3595	37.3%
	85+	2335	24.2%
RHA of Residence	Sun Country	655	6.8%
	Five Hills	738	7.7%
	Cypress	640	6.6%
	Regina Qu'Appelle	2041	21.2%
	Sunrise	874	9.1%
	Saskatoon	2396	25.0%
	Heartland	563	5.9%
	Kelsey Trail	568	5.9%
	Prince Albert Parkland	614	6.4%
	Prairie North	474	4.9%
	Northern Saskatchewan	59	0.6%
Income Quintile	1 (Lowest)	1673	19.9%
	2	2092	25.0%
	3	1859	22.1%
	4	1535	18.3%
	5 (Highest)	1241	14.8%
Urban/Non-Urban	Urban	4842	50.4%
	Non-Urban	4758	49.6%
Hospital Category	Provincial	4575	47.4%
	Regional	1838	19.1%
	District	1156	12.0%
	Community and Northern	2074	21.5%
Length of Stay	1-10 days	5873	60.9%
	11-30 days	2279	23.6%
	31+ days	1493	15.5%
Multiple Stroke/TIA	Not a multiple stroke/TIA	9047	93.8%
	Multiple stroke/TIA	598	6.2%

4.2 Question One: Indicators of the Quality of Secondary Stroke Prevention

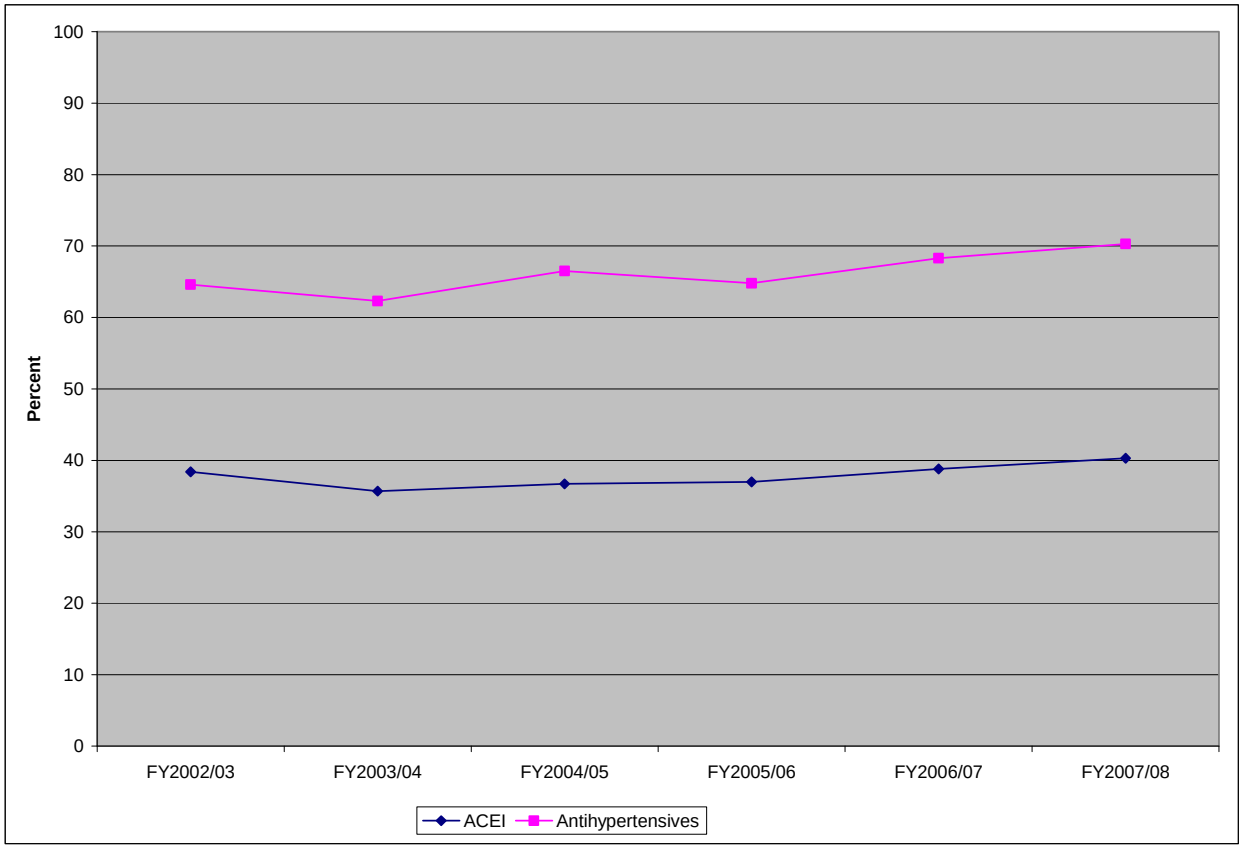
4.2.1 Medication-Related Process of Care Indicators

The results for the process of care indicators show the percent of stroke/TIA cases that were dispensed medications for secondary stroke event prevention such that they had a daily supply of the medication at 3 and 90 days post-discharge. All results are presented by fiscal year. The results in fiscal year 2001/02 were unreliable due to missing information, and thus removed from all figures.

4.2.1.1 Antihypertensive Indicator Results – All Stroke/TIA

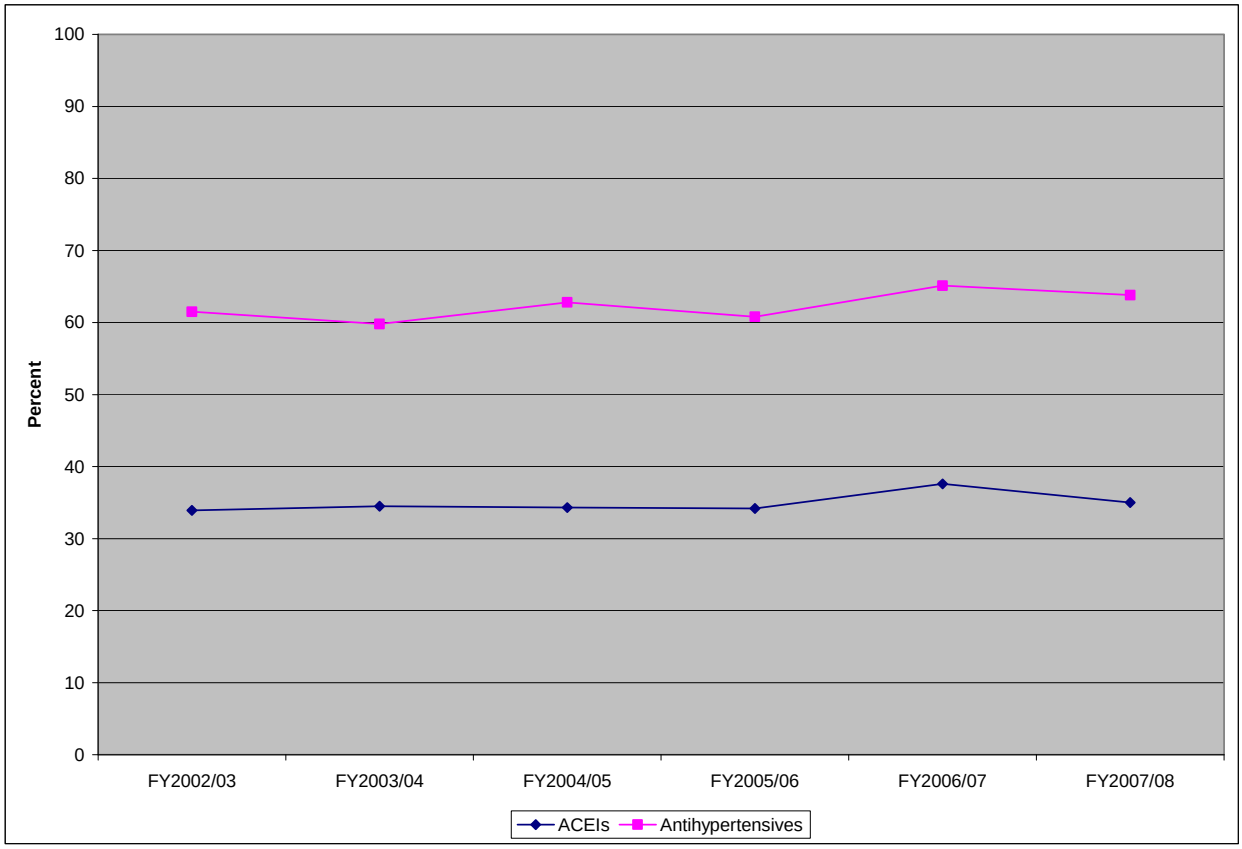
Figures 4.1 and 4.2 present the results for the 3-day and 90-day antihypertensive indicators. It should be noted that ACEIs are a major antihypertensive drug class subset, and therefore separate results are shown on the figures. Figure 4.1 shows the percentage of stroke/TIA patients on ACEIs and antihypertensives at 3 days by fiscal year, while Figure 4.2 illustrates the percentage of patients on ACEIs and antihypertensives at 90 days by fiscal year.

Figure 4.1: Percentage of stroke/TIA patients on ACEI or any antihypertensive medication (including ACEI) at 3 days post-discharge, by fiscal year



		2002/03	2003/04	2004/05	2005/06	2006/07	2007/08
Antihyps	Percent	64.6	62.3	66.5	64.8	68.3	70.3
	95% CI	62.1-67.0	59.6-64.8	63.9-68.9	62.3-67.3	65.8-70.8	67.7-72.8
ACEI	Percent	38.4	35.7	36.7	37.0	38.8	40.3
	95% CI	35.9-40.9	33.2-38.3	34.2-39.3	34.5-39.6	36.2-41.4	37.6-43.0

Figure 4.2: Percentage of stroke/TIA patients on ACEI or any antihypertensive medication (including ACEI) at 90 days post-discharge, by fiscal year



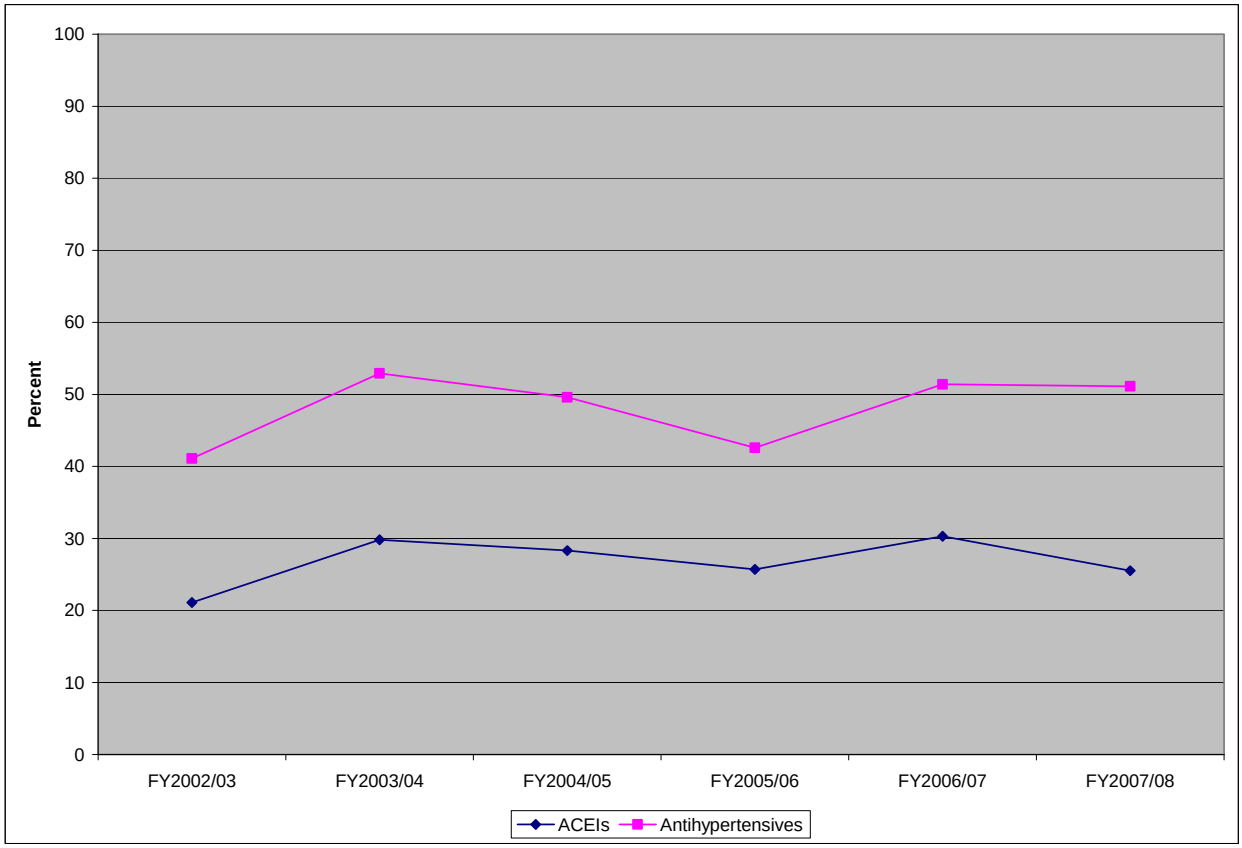
		2002/03	2003/04	2004/05	2005/06	2006/07	2007/08
Antihyps	Percent	61.5	59.8	62.8	60.8	65.1	63.8
	95% CI	58.9-64.2	57.1-62.4	60.1-65.4	58.2-63.4	62.5-67.7	61.0-66.4
ACEI	Percent	33.9	34.5	34.3	34.2	37.6	35.0
	95% CI	31.4-36.6	31.9-37.1	31.7-37.0	31.7-36.8	35.0-40.3	32.4-37.7

From fiscal year 2002/03 to 2007/08 there was a statistically significant increase (<10%) in the number of patients on antihypertensives at 3 days post-discharge. This change is indicated by the non-overlapping confidence intervals in the first and last years. The 90-day results do not show this same change over time, and instead the results appear fairly constant. In the most recent fiscal year, 70.3% of all stroke/TIA patients were on antihypertensives at 3 days, and 63.8% were on medication at 90 days.

4.2.1.2 Antihypertensive Indicator Results – Hemorrhagic Stroke

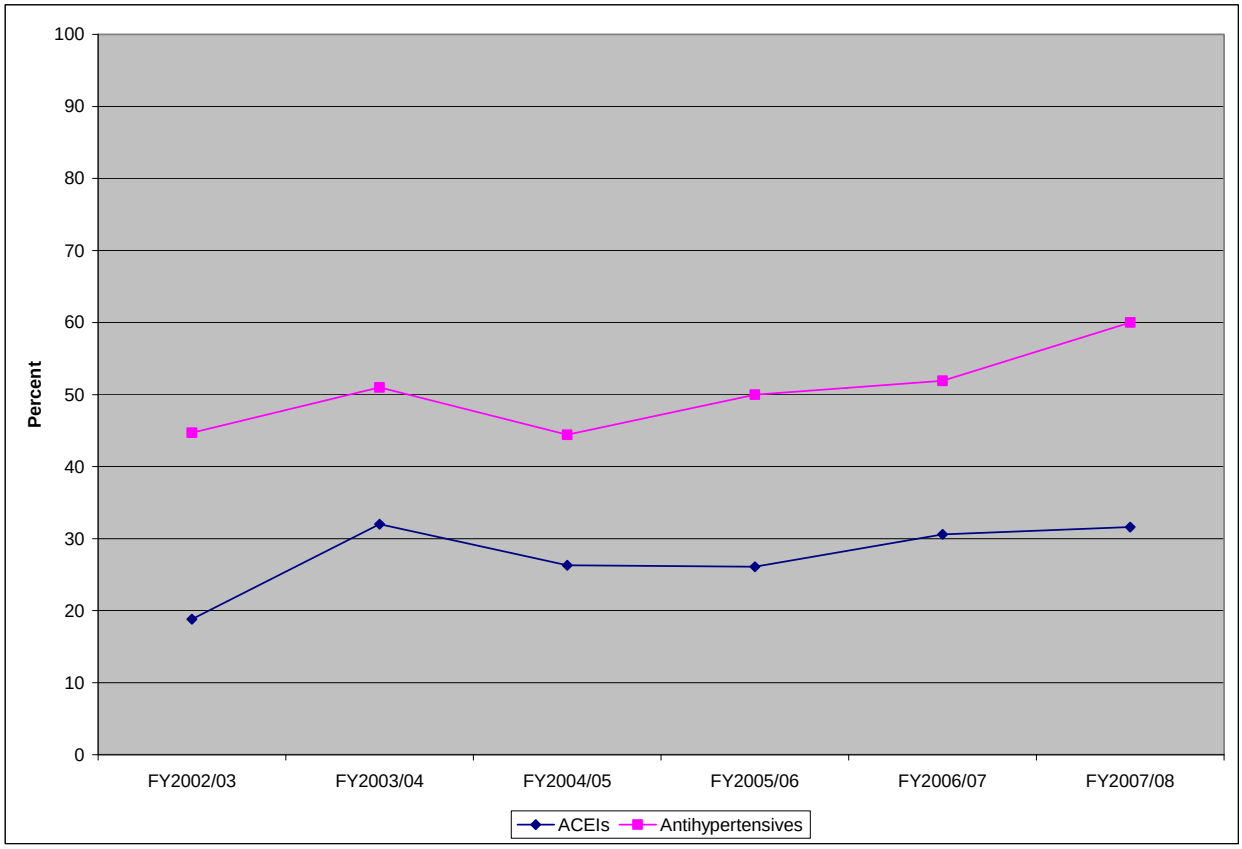
Figures 4.3 and 4.4 present the results for the 3-day and 90-day antihypertensive indicators for patients who had a hemorrhagic stroke. Again, it should be noted that ACEIs are a major antihypertensive drug class subset, and therefore separate results are shown on the figures. Figure 4.3 shows the percentage of hemorrhagic stroke patients on ACEIs and antihypertensives at 3 days by fiscal year. Figure 4.4 illustrates the percentage of hemorrhagic stroke patients on ACEIs and antihypertensives at 90 days by fiscal year.

Figure 4.3: Percentage of hemorrhagic stroke patients on ACEI or any antihypertensive medication (including ACEI) at 3 days post-discharge, by fiscal year



		2002/03	2003/04	2004/05	2005/06	2006/07	2007/08
Antihyps	Percent	41.1	52.9	49.6	42.6	51.4	51.1
	95% CI	31.1-51.6	42.8-62.8	40.0-59.1	32.8-52.8	41.6-61.1	40.5-61.5
ACEI	Percent	21.1	29.8	28.3	25.7	30.3	25.5
	95% CI	13.4-30.6	21.2-39.6	20.2-37.6	17.6-35.4	21.8-39.8	17.1-35.6

Figure 4.4: Percentage of hemorrhagic stroke patients on ACEI or any antihypertensive medication (including ACEI) at 90 days post-discharge, by fiscal year



		2002/03	2003/04	2004/05	2005/06	2006/07	2007/08
Antihyps	Percent	44.7	51.0	44.4	50.0	51.9	60.0
	95% CI	33.9-55.9	40.8-61.1	34.5-54.8	39.4-60.6	42.0-61.6	49.4-69.9
ACEI	Percent	18.8	32.0	26.3	26.1	30.6	31.6
	95% CI	11.2-28.8	23.0-42.1	17.9-36.1	17.5-36.3	22.1-40.2	22.4-41.9

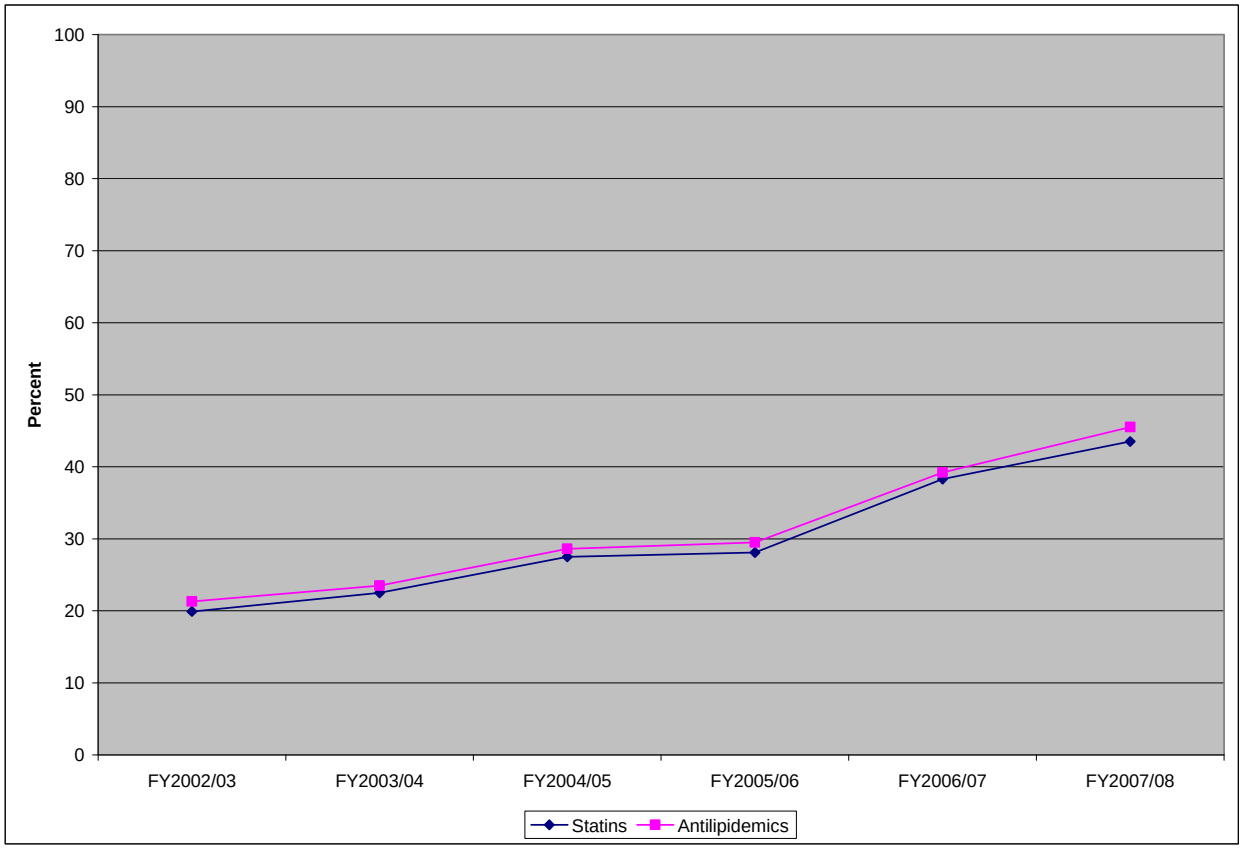
Compared to all stroke/TIA, it looks as if a lower percentage (4%-20%) of hemorrhagic stroke patients were on medication in the most recent fiscal year. In fiscal year 2007/08, 51.1% of hemorrhagic stroke patients were on antihypertensives at 3 days, and 60% were on at 90 days.

4.2.1.3 Antilipidemic Indicator Results – All Stroke/TIA

Figures 4.5 and 4.6 present the results for the 3-day and 90-day antilipidemic indicators. It should be noted that statins are a major antilipidemic drug class subset, and separate results are presented on these figures. Figure 4.5 shows the percentage of stroke/TIA patients on statins and

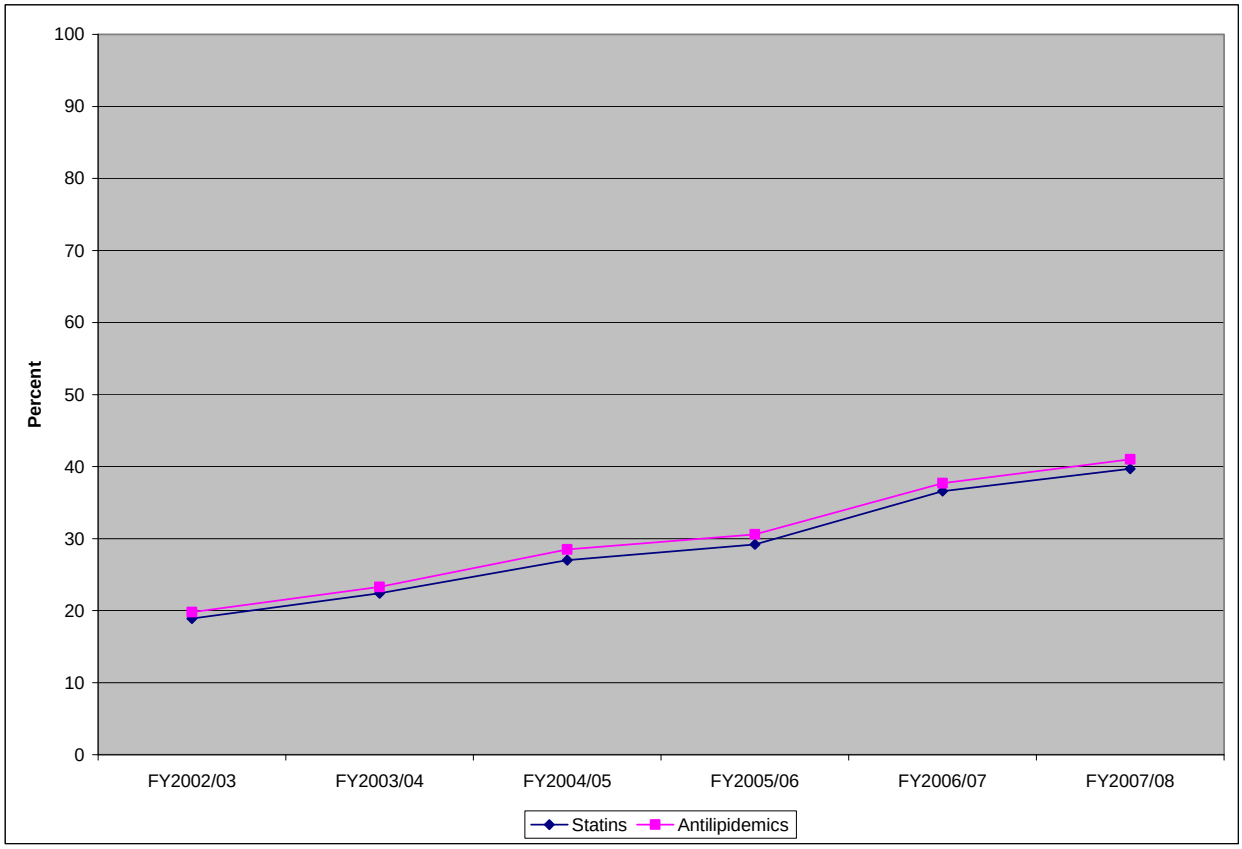
antilipidemics at 3 days by fiscal year, while Figure 4.6 illustrates the percentage of patients on statins and antilipidemics at 90 days by fiscal year.

Figure 4.5: Percentage of stroke/TIA patients on statin or any antilipidemic medication (including statins) at 3 days post-discharge, by fiscal year



		2002/03	2003/04	2004/05	2005/06	2006/07	2007/08
Antilips	Percent	21.3	23.5	28.6	29.5	39.2	45.5
	95% CI	19.2-23.4	21.2-25.8	26.0-31.0	27.2-31.9	36.7-41.9	42.8-48.3
Statin	Percent	19.9	22.5	27.5	28.1	38.3	43.5
	95% CI	18.0-22.0	20.3-24.8	25.2-29.9	25.8-30.5	35.7-40.9	40.8-46.3

Figure 4.6: Percentage of stroke/TIA patients on statin or any antilipidemic medication (including statins) at 90 days post-discharge, by fiscal year



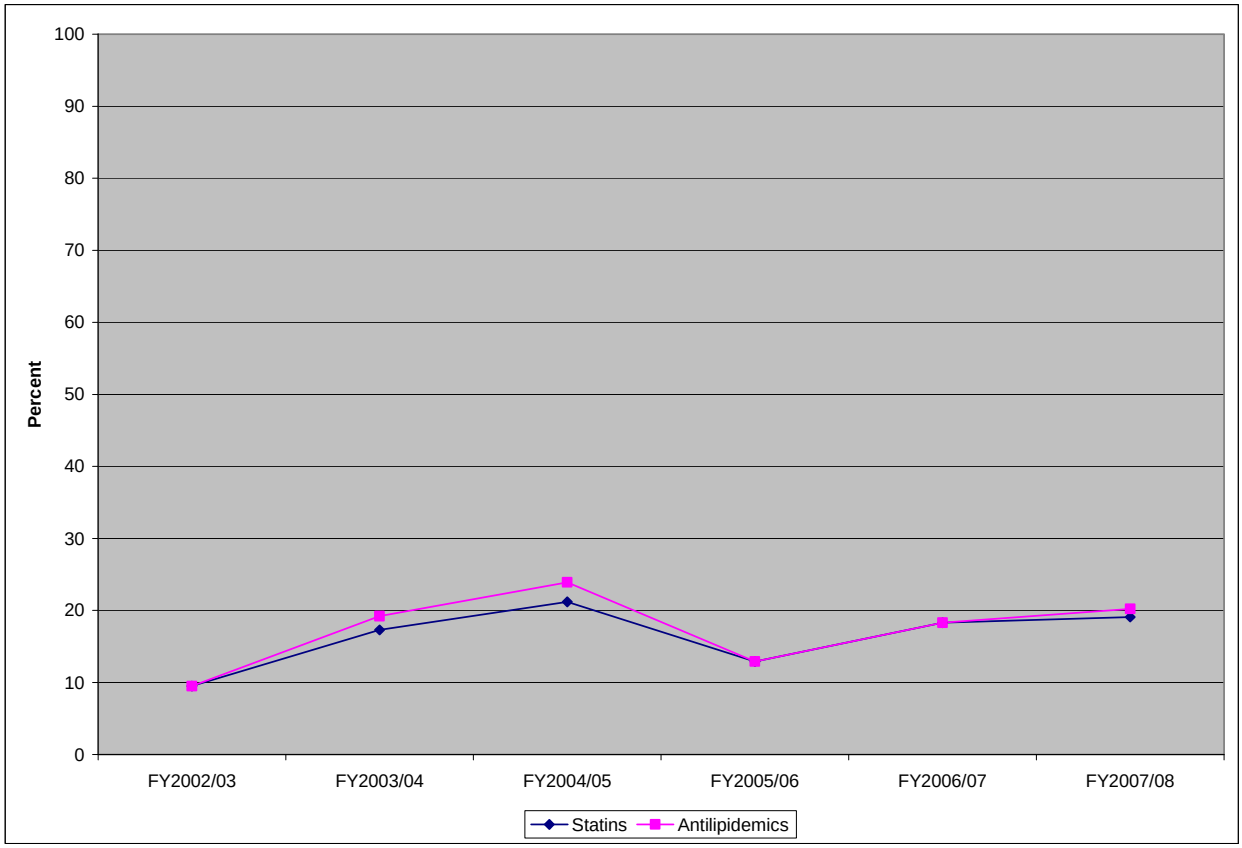
		2002/03	2003/04	2004/05	2005/06	2006/07	2007/08
Antilips	Percent	19.8	23.3	28.5	30.6	37.7	41.0
	95% CI	17.6-22.0	21.0-25.6	26.1-31.1	28.1-33.1	35.1-40.4	38.2-43.7
Statin	Percent	18.9	22.4	27.0	29.2	36.6	39.7
	95% CI	16.9-21.1	20.2-24.7	24.6-29.5	26.8-31.7	34.0-39.3	37.0-42.5

Due to the fact that the percentage of patients on statins and the percentage on antilipidemics was very close (<2% difference), the rest of the results are presented using the statin results only. From fiscal year 2003/03 to 2007/08, it is apparent that the percentage of patients on statins at both 3 and 90 days post-discharge has doubled from approximately 20% to approximately 40%. This change over time was statistically significant at both 3 and 90 days. In the most recent fiscal year, 43.5% of all stroke/TIA patients were on statins at 3 days, while 39.7% were on statins at 90 days.

4.2.1.4 Antilipidemic Indicator Results – Hemorrhagic Stroke

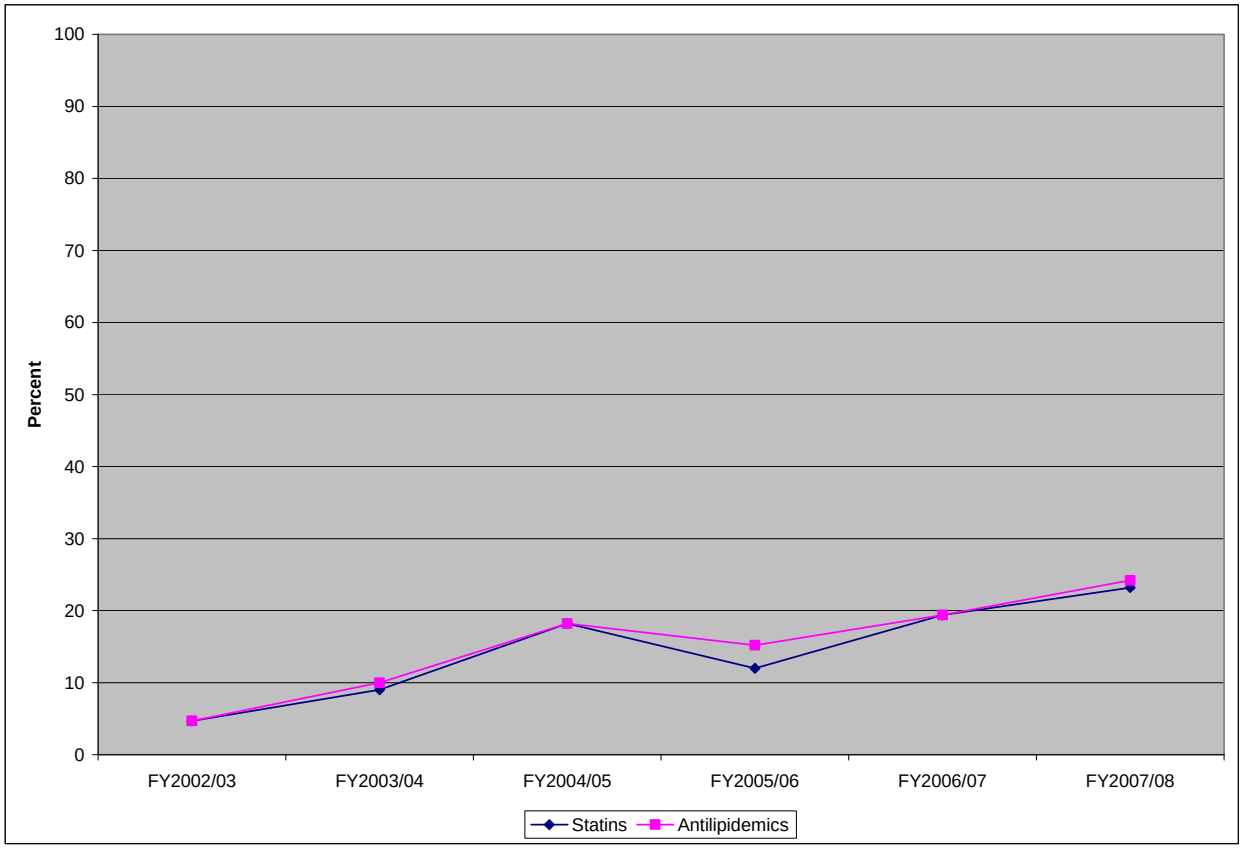
Figures 4.7 and 4.8 present the results for the 3-day and 90-day antilipidemic indicators for patients who had a hemorrhagic stroke. Again, it should be noted that statins are a major antilipidemic drug class subset, and therefore separate results are shown on the figures. Figure 4.7 shows the percentage of hemorrhagic stroke patients on statins and antilipidemics at 3 days by fiscal year. Figure 4.8 illustrates the percentage of hemorrhagic stroke patients on statins and antilipidemics at 90 days by fiscal year.

Figure 4.7: Percentage of hemorrhagic stroke patients on statin or any antilipidemic medication (including statins) at 3 days post-discharge, by fiscal year



		2002/03	2003/04	2004/05	2005/06	2006/07	2007/08
Antilips	Percent	9.5	19.2	23.9	12.9	18.3	20.2
	95% CI	4.4-17.2	12.2-28.1	16.4-32.8	7.0-21.0	11.6-26.9	12.6-29.8
Statin	Percent	9.5	17.3	21.2	12.9	18.3	19.1
	95% CI	4.4-17.2	10.6-26.0	14.1-29.9	7.0-21.0	11.6-26.9	11.8-28.6

Figure 4.8: Percentage of hemorrhagic stroke patients on statin or any antilipidemic medication (including statins) at 90 days post-discharge, by fiscal year



		2002/03	2003/04	2004/05	2005/06	2006/07	2007/08
Antilips	Percent	4.7	10.0	18.2	15.2	19.4	24.2
	95% CI	1.3-11.6	4.9-17.6	11.1-27.2	8.6-24.2	12.5-28.2	16.0-34.1
Statin	Percent	4.7	9.0	18.2	12.0	19.4	23.2
	95% CI	1.3-11.6	4.2-16.4	11.1-27.2	6.1-20.4	12.5-28.2	15.1-32.9

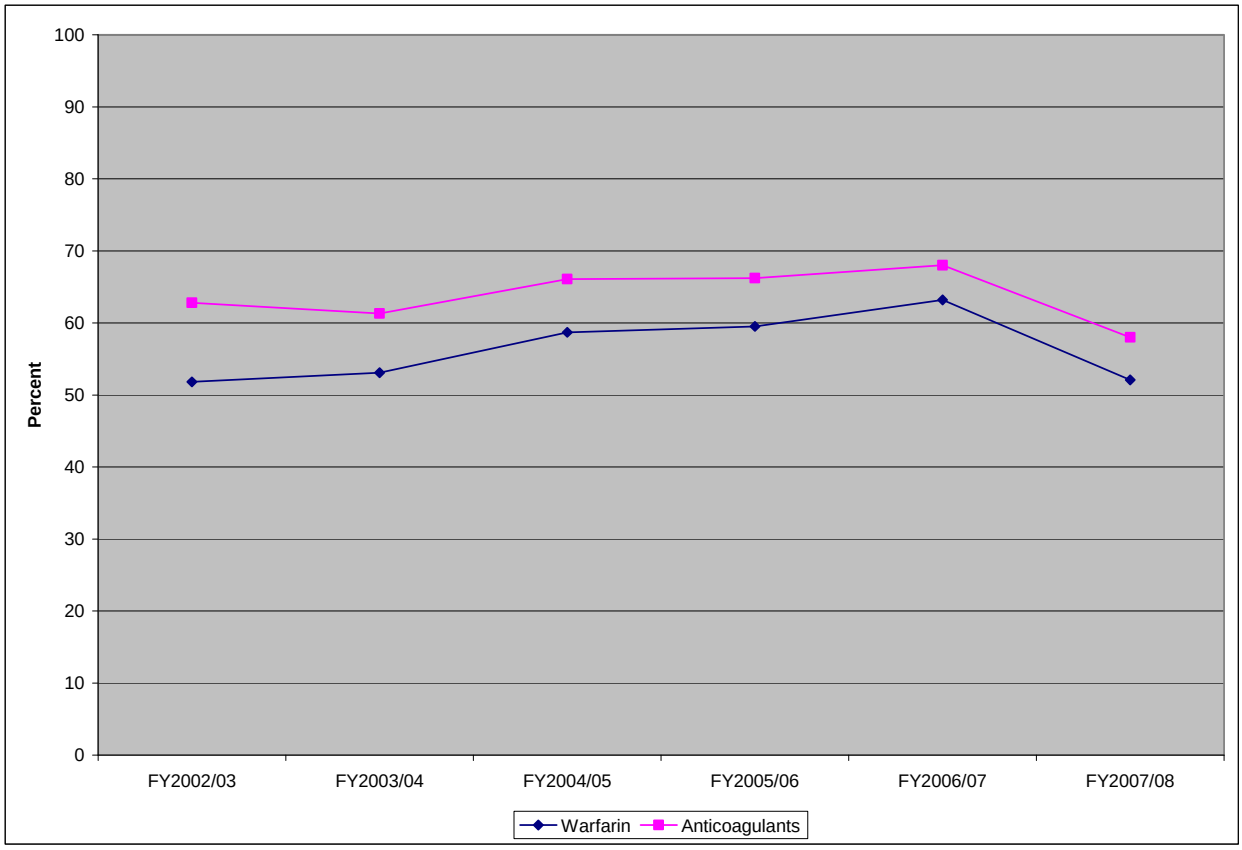
Contrary to those with all stroke/TIA, it appears that a much lower percentage (approximately 20%) of hemorrhagic stroke patients were on statin medication at both 3 and 90 days post-discharge in the most recent fiscal year. In 2007/08, 19.1% of hemorrhagic stroke patients were on statins at 3 days, while 23.2% were on statins at 90 days.

4.2.1.5 Anticoagulant Indicator Results – All Stroke/TIA

Figures 4.9 and 4.10 present the results for the 3-day and 90-day anticoagulant indicators. All indicators involved only those patients who had a stroke/TIA and atrial fibrillation. It should be noted that warfarin is a major anticoagulant drug class subset, and therefore results are

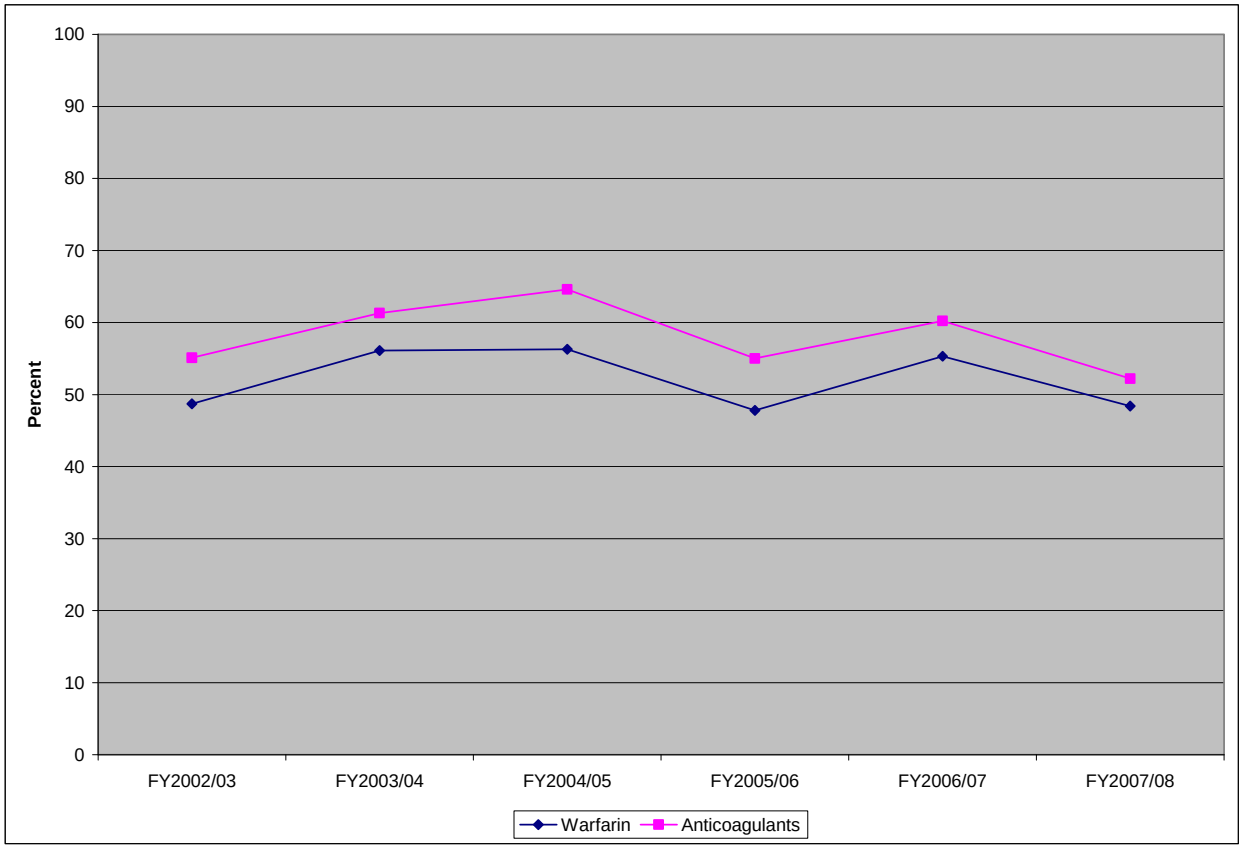
presented separately in the figures. Figure 4.9 shows the percentage of stroke/TIA patients on warfarin and anticoagulants at 3 days post-discharge by fiscal year. Figure 4.10 illustrates the percentage of patients on warfarin and anticoagulants at 90 days by fiscal year.

Figure 4.9: Percentage of stroke/TIA patients with atrial fibrillation on warfarin or any anticoagulant medication (including warfarin) at 3 days post-discharge, by fiscal year



		2002/03	2003/04	2004/05	2005/06	2006/07	2007/08
Anticos	Percent	62.8	61.3	66.1	66.2	68.0	58.0
	95% CI	55.6-69.7	53.2-68.8	58.9-72.8	59.0-72.8	61.5-73.9	50.6-65.1
Warfarin	Percent	51.8	53.1	58.7	59.5	63.2	52.1
	95% CI	44.5-59.1	45.1-61.0	51.4-65.8	52.2-66.4	56.6-69.4	44.7-59.5

Figure 4.10: Percentage of stroke/TIA patients with atrial fibrillation on warfarin or any anticoagulant medication (including warfarin) at 90 days post-discharge, by fiscal year



		2002/03	2003/04	2004/05	2005/06	2006/07	2007/08
Anticos	Percent	55.1	61.3	64.6	55.0	60.2	52.2
	95% CI	47.0-63.0	53.1-69.0	56.6-72.0	47.4-62.4	53.2-66.9	44.7-59.6
Warfarin	Percent	48.7	56.1	56.3	47.8	55.3	48.4
	95% CI	40.7-56.8	47.9-64.1	48.2-64.2	40.3-55.3	48.3-62.3	41.0-55.8

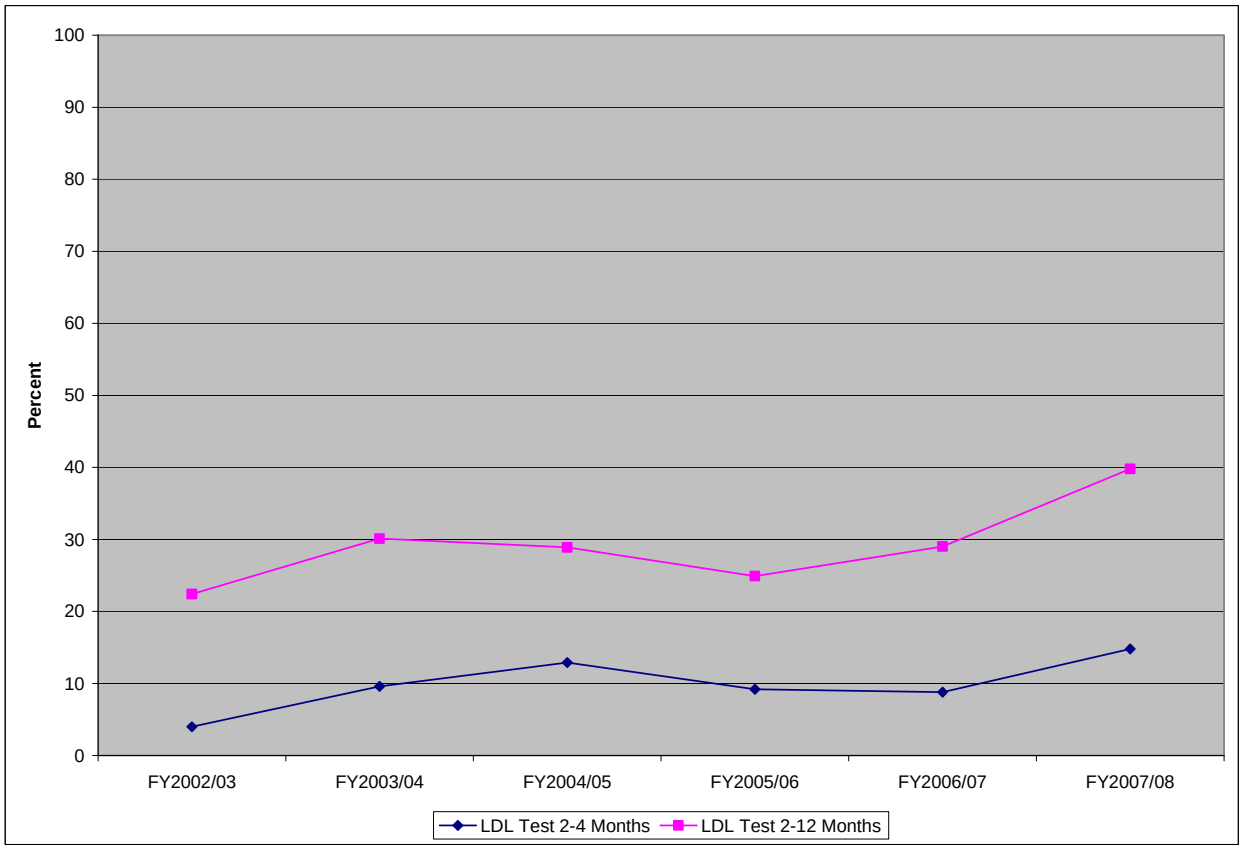
From fiscal year 2002/03 to 2007/08, it seems there has not been much change in the number of patients taking anticoagulants at both 3 and 90 days post-discharge. The percentage varied over the years between 52% and 68%. In the most recent fiscal year, 58.0% of all stroke/TIA patients were on anticoagulants at 3 days, and 52.2% were on at 90 days. Interestingly, these percentages are the lowest of all the fiscal years, but the confidence interval does overlap with that from earliest year meaning there is no significant difference. For comparative purposes, it should be noted that approximately 56% of stroke patients with atrial fibrillation were on warfarin at 3 days post-discharge over all fiscal years.

4.2.2 LDL Intermediate Outcome Indicator Results

The results for the indicators involving LDL-C tests are presented for all stroke/TIA. All results are presented by fiscal year. The results in fiscal year 2001/02 were unreliable, and thus removed from all figures. As laboratory data was able to be acquired from only the Saskatoon and Regina Qu'Appelle RHAs, all LDL-C figures contain results for just the patients who live in these two RHAs.

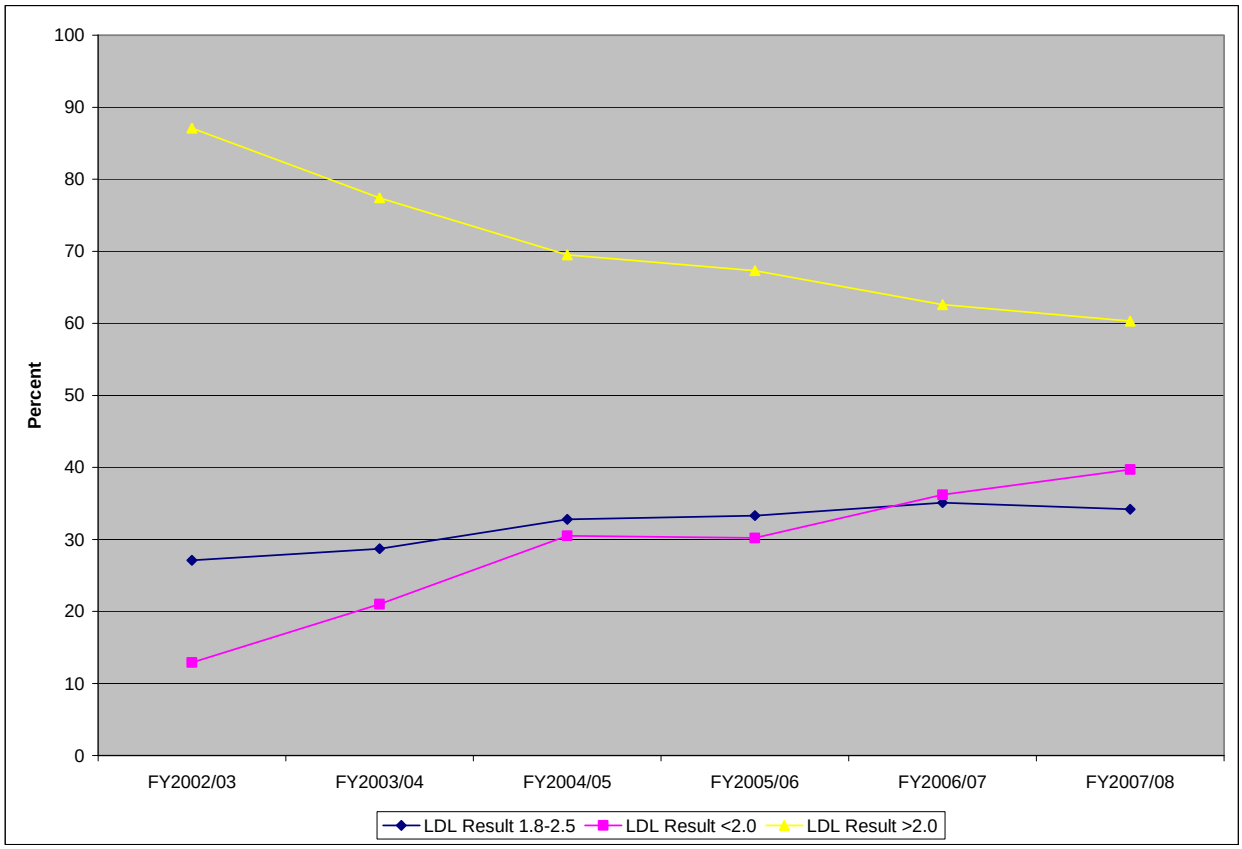
Figures 4.11-4.12 present the results for the LDL-C test indicators. Figure 4.11 shows the percentage of stroke/TIA patients living in Saskatoon or Regina Qu'Appelle given at least one LDL-C test between 2-4 months or between 2-12 months post-discharge by fiscal year. Figure 4.12 illustrates the percentage of stroke/TIA patients living in Saskatoon or Regina Qu'Appelle given at least one LDL-C test that are within the defined result ranges on their most recent test 2-12 months post-discharge by fiscal year.

Figure 4.11: Percentage of stroke/TIA patients living in Saskatoon or Regina Qu'Appelle given at least one LDL-C test between 2-4 months or between 2-12 months post-discharge, by fiscal year



		2002/03	2003/04	2004/05	2005/06	2006/07	2007/08
LDL 2-12	Percent	22.4	30.1	28.9	24.9	29.0	39.8
	95% CI	19.2-25.8	26.6-33.8	25.3-32.6	21.6-28.4	25.4-32.8	35.8-43.8
LDL 2-4	Percent	4.0	9.6	12.9	9.2	8.8	14.8
	95% CI	2.6-5.8	7.4-12.1	10.3-15.8	7.1-11.7	6.7-11.4	12.0-17.9

Figure 4.12: Percentage of stroke/TIA patients living in Saskatoon or Regina Qu'Appelle given at least one LDL-C test between 2-12 months post-discharge within the defined LDL-C test result ranges on their most recent test, by fiscal year



From fiscal year 2002/03 to 2007/08, there has been a substantial increase (approximately 20%) in the number of stroke/TIA patients living in Saskatoon or Regina Qu'Appelle given at least one LDL-C test 2-12 months post-discharge. This change was statistically significant as the confidence intervals from the earliest and latest years did not overlap. In the most recent fiscal year, 39.8% of all stroke/TIA patients were given a test. It should be noted, however, that the original LDL-C indicator timeline was 2-4 months post-discharge, not 2-12 months. The timeline had to be extended because the test numbers at 2-4 months were too small even in the most recent fiscal year (14.8%).

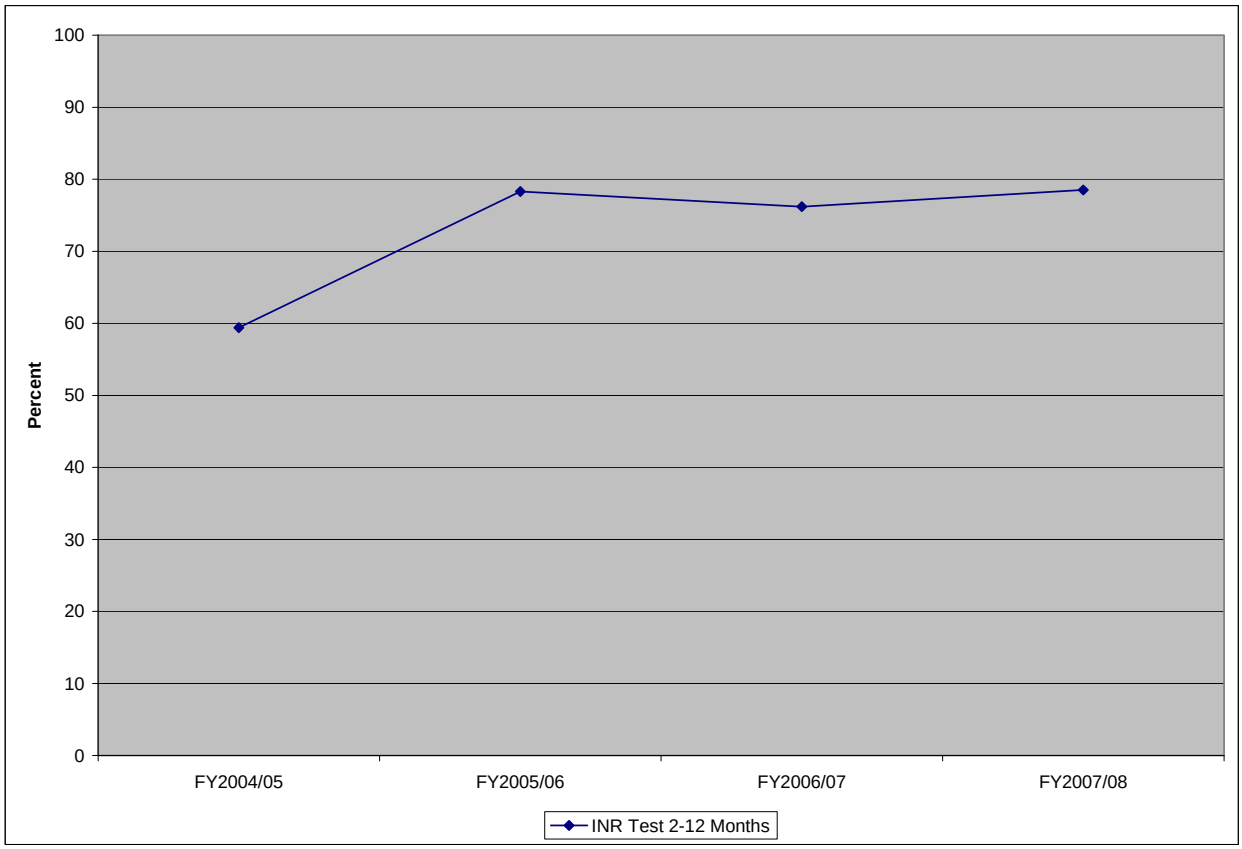
Over the last six fiscal years, there has been a substantial decrease in the number of patients with an LDL-C level higher than 2.0. However, of the patients given a test, majority still had a result higher than 2.0 in the most recent fiscal year (60.3%).

4.2.3 INR Intermediate Outcome Indicator Results

The results for the indicators involving INR tests are presented for all stroke/TIA in patients taking warfarin at 3 or 90 days post-discharge. All results are presented by fiscal year. The results begin at fiscal year 2004/05 as data before this year was unavailable. As laboratory data was able to be acquired from only the Saskatoon and Regina Qu'Appelle RHAs, all INR figures contain results for just the patients who live in these two RHAs.

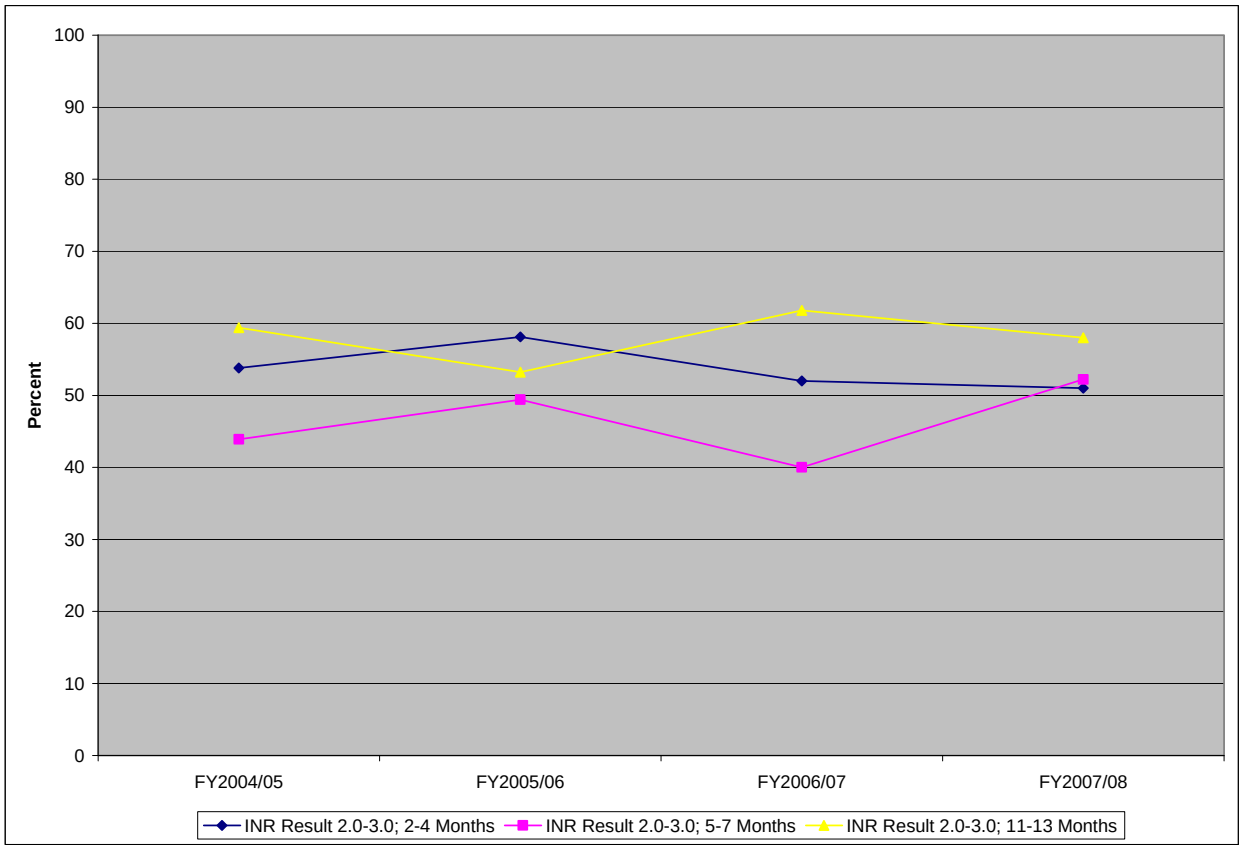
Figures 4.13 and 4.14 present the results for the INR test indicators. Figure 4.13 shows the percentage of stroke/TIA patients on warfarin at 3 or 90 days post-discharge given at least one INR test 2-12 months post-discharge by fiscal year. Further, Figure 4.14 illustrates the percentage of stroke/TIA patients on warfarin at 3 or 90 days post-discharge given at least one INR test 2-4, 5-7, or 11-13 months that have a test result 2.0-3.0 by fiscal year.

Figure 4.13: Percentage of stroke/TIA patients, living in Saskatoon or Regina Qu'Appelle, on warfarin at 3 or 90 days post-discharge given at least one INR test 2-12 months post-discharge, by fiscal year



		2004/05	2005/06	2006/07	2007/08
INR 2-12	Percent	59.4	78.3	76.2	78.5
	95% CI	50.9-67.6	70.7-84.8	68.5-82.8	71.1-84.8

Figure 4.14: Percentage of stroke/TIA patients, living in Saskatoon or Regina Qu'Appelle, on warfarin at 3 or 90 days post-discharge given at least one INR test at 2-4 months, 5-7 months, or 11-13 months post-discharge with results 2.0-3.0, by fiscal year



From fiscal year 2004/05 to 2007/08, the number of stroke/TIA patients living in Saskatoon or Regina Qu'Appelle on warfarin and given at least one INR test in the year following their discharge has increased by almost 20%. This change over time was statistically significant. In the most recent fiscal year, 78.5% of patients on warfarin were given at least one INR test. However, when the proportions of patients within range were examined at 3, 6, and 12 months, it became apparent that only 40-60% of patients given an INR test were within therapeutic range.

4.2.4 Question One Results Summary

To provide a brief review and synopsis of the results from the indicators, the important points are presented below in condensed form.

The antihypertensive indicators showed that there has been a slight increase in the number of patients on the medication over the time period, but about 30-40% of patients are not

on the drugs at discharge. Further, a lower percentage of hemorrhagic stroke patients were on antihypertensives in the most recent fiscal year compared to all stroke/TIA.

The antilipidemic indicators illustrated that the percentage of patients on statins has doubled over the timeframe, but roughly 50-60% of all patients are not on the medication at discharge. In addition, a much lower percentage of hemorrhagic stroke patients were placed on statins in the most recent fiscal year compared to all stroke/TIA.

The anticoagulant indicators showed that there has not been much change over the time period in the number of patients with atrial fibrillation placed on medication. However, approximately 40-50% of patients with atrial fibrillation are not on anticoagulants at discharge.

In all medication-related indicators, the results at 3 and 90 days post-discharge were fairly similar over all fiscal years.

The LDL-C indicators revealed that, though there has been an increase over the timeframe in the number of patients living in Saskatoon or Regina Qu'Appelle given a test, about 60% of patients are not receiving even one LDL-C test 2-12 months post-discharge. Further, approximately 60% of the patients who received a test have an LDL-C level higher than 2.0

Finally, the INR indicators established that there has been an increase over the time period in the number of patients on warfarin (living in Saskatoon or Regina Qu'Appelle) given an INR test 2-12 months post-discharge. However, about half of the patients given a test were not within therapeutic range.

4.3 Question Two: Correlates Associated with Receiving Secondary Stroke Prevention

As the literature indicates that different factors may influence the provision of secondary stroke prevention, separate models were constructed for the various areas of care. Five models were developed to predict 1) being "on" antihypertensive medication at 90 days post-discharge; 2) being "on" antilipidemic medication at 90 days post-discharge; 3) being "on" anticoagulant medication at 90 days post-discharge; 4) being given at least one LDL-C test 2-12 months post-discharge; and 5) being given at least one INR test 2-12 months post-discharge.

4.3.1 Model for Being "On" Antihypertensive Medication

Table 4.3 describes the statistically and clinically significant correlates for being "on" antihypertensive medication at 90 days post-discharge.

Table 4.3: Statistically and clinically significant correlates for being "on" antihypertensive medication at 90 days post-discharge

Correlates	Categories	Odds Ratio	95% Confidence Interval
Sex	Male	N/A	N/A
	Female		
Age	18-74	N/A	N/A
	75-84		
	85+		
Urban/Non-Urban	Urban	(ref)	(ref)
	Non-urban	**1.15**	**1.05-1.27***
Previously on Drugs	Not previously on drug	(ref)	(ref)
	Previously on drug	**2.33**	**2.12-2.57***
Sex*Age	Male * Age<74	(ref)	(ref)
	Female * Age <74	0.86	0.75-1.00
	Male * Age 75-84	(ref)	(ref)
	Female * Age 75-84	**1.39**	**1.19-1.63***
	Male * Age 85+	(ref)	(ref)
	Female * Age 85+	**2.20**	**1.76-2.74***

*** Statistically Significant**

As shown in Table 4.3, patients who lived in a non-urban setting were more likely to be on antihypertensive medication than patients who lived in an urban setting (OR=1.15). Also, people who were taking antihypertensives before their stroke event were more often on the medication at 90 days compared to those who were not previously on the drugs (OR=2.33).

The presence of a statistically significant interaction term between sex and age implies that neither of the terms can be examined in isolation. This means that when looking at the impact of sex on taking antihypertensive medication at 90 days, it must be explained in the context of age. Looking at Table 4.3, females, compared to males, were more likely to be on antihypertensive medications, but this was dependent on age. Older females (75-84 and 85+) were more likely to be on antihypertensives (OR=1.39 and OR=0.86), whereas younger females (<75) were not (OR=0.86).

The Hosmer and Lemeshow goodness-of-fit test had a p-value equal to 0.9594. This means that the null hypothesis (stating that the model fits) is not rejected, and that the model seems to fit the data quite well.

4.3.2 Model for Being "On" Antilipidemic Medication

Table 4.4 describes the statistically and clinically significant correlates for being "on" antilipidemic medication at 90 days post-discharge

Table 4.4: Statistically and clinically significant correlates for being "on" antilipidemic medication at 90 days post-discharge

Correlates	Categories	Odds Ratio	95% Confidence Interval
Sex	Male	(ref)	(ref)
	Female	0.94	0.84-1.06
Age	**18-74**	**1.35**	**1.19-1.53***
	75-84	(ref)	(ref)
	85+	**0.47**	**0.39-0.56***
RHA of Residence	**Sun Country**	**0.74**	**0.56-0.99***
	Five Hills	**1.60**	**1.21-2.12***
	Cypress	0.77	0.57-1.04
	Regina Qu'Appelle	**0.82**	**0.70-0.96***
	Sunrise	0.93	0.72-1.22
	Saskatoon	(ref)	(ref)
	Heartland	0.92	0.69-1.24
	Kelsey Trail	1.03	0.76-1.40
	Prince Albert Parkland	1.30	0.98-1.74
	Prairie North	0.91	0.67-1.22
	Mamawetan Churchill River	2.76	0.76-10.04
	Keewatin Yatthé	0.42	0.09-2.06
Income Quintile	1 (Lowest)	(ref)	(ref)
	2	1.10	0.92-1.31
	3	**1.24**	**1.03-1.48***
	4	**1.26**	**1.04-1.52***
	5 (Highest)	0.96	0.78-1.18
Hospital Category	Provincial	(ref)	(ref)
	Regional	0.86	0.69-1.08
	District	**0.78**	**0.62-0.99***
	Northern	1.11	0.22-5.61
	Community	**0.62**	**0.52-0.75***
Previously on Drugs	Not previously on drug	(ref)	(ref)
	Previously on drug	**5.04**	**4.47-5.70***

*** Statistically Significant**

As shown in Table 4.4, patients who were under age 75 were more likely (OR=1.35), while those who were over 85 were less likely (OR=0.47) to be on antilipidemic medication compared to those age 75-84. People within the income quintiles 3 (OR=1.24) and 4 (OR=1.26) were more often on medication than those in the lowest quintile. Those discharged from a

hospital categorized as district (OR=0.78) or community (OR=0.62) were less likely to be on antilipidemics than those from a provincial hospital. Further, people who were taking antilipidemics before their stroke event were more often on the medication at 90 days compared to those who were not previously on the drugs (OR=5.04).

As can be seen in Table 4.4, the odds ratio for RHA is statistically significant for three of the twelve regions included. Patients who lived in Sun Country (OR=0.74) or Regina Qu'Appelle (OR=0.82) were less likely to be on antilipidemics than those who lived in Saskatoon (reference). In contrast, those who lived in Five Hills (OR=1.60) were more often on the medication than patients who lived in Saskatoon (reference).

The Hosmer and Lemeshow goodness-of-fit test had a p-value equal to <0.001. This means that the null hypothesis (stating that the model fits) is rejected. Therefore, it seems this model is not a good fit to the data.

4.3.3 Model for Being "On" Anticoagulant Medication

Table 4.5 describes the statistically and clinically significant correlates for being "on" anticoagulant medication at 90 days post-discharge in those with atrial fibrillation.

Table 4.5: Statistically and clinically significant correlates for being "on" anticoagulant medication at 90 days post-discharge in those with atrial fibrillation

Correlates	Categories	Odds Ratio	95% Confidence Interval
Sex	Male	(ref)	(ref)
	Female	1.19	0.90-1.59
Age	18-74	1.11	0.78-1.56
	75-84	(ref)	(ref)
	85+	**0.67**	**0.48-0.93***
Income Quintile	1 (Lowest)	(ref)	(ref)
	2	1.17	0.79-1.73
	3	1.53	1.00-2.33
	4	**2.12**	**1.35-3.32***
	5 (Highest)	1.26	0.81-1.96
Length of Stay	0-10 days	(ref)	(ref)
	11-30 days	1.01	0.73-1.41
	31+ days	**0.68**	**0.48-0.96***
Previously on Drugs	Not previously on drug	(ref)	(ref)
	Previously on drug	**1.56**	**1.10-2.20***

*** Statistically Significant**

As illustrated in Table 4.5 patients who were over age 85 were less likely to be on anticoagulant medication compared to those age 75-84. People within the 4th income quintile were more often on medication than those in the lowest quintile (OR=2.12). Patients who were hospitalized for more than 31 days were on anticoagulants less often than those with a stay 0-10 days. Finally, people who were taking anticoagulants before their stroke event were more often on the medication at 90 days compared to those who were not previously on the drugs (OR=1.56).

The Hosmer and Lemeshow goodness-of-fit test had a p-value equal to 0.1825. This means that the null hypothesis (stating that the model fits) is not rejected. Therefore, this model seems to fit the data.

4.3.4 Model for Being Given At Least One LDL-C Test

Table 4.6 describes the statistically and clinically significant correlates for being given at least one LDL-C test 2-12 months post-discharge.

Table 4.6: Statistically and clinically significant correlates for being given at least one LDL-C test 2-12 months post-discharge

Correlates	Categories	Odds Ratio	95% Confidence Interval
Sex	Male	(ref)	(ref)
	Female	**0.82**	**0.70-0.97***
Age	**18-74**	**1.56**	**1.32-1.85***
	75-84	(ref)	(ref)
	85+	**0.29**	**0.22-0.39***
Income Quintile	1 (Lowest)	(ref)	(ref)
	2	1.25	1.00-1.57
	3	1.08	0.85-1.37
	4	1.16	0.91-1.48
	5 (Highest)	**1.50**	**1.15-1.94***
Urban/Non-Urban	Urban	(ref)	(ref)
	Non-urban	**0.23**	**0.18-0.29***
Length of Stay	0-10 days	(ref)	(ref)
	11-30 days	**0.75**	**0.61-0.90***
	31+ days	**0.57**	**0.45-0.71***

*** Statistically Significant**

As shown in Table 4.6, patients under age 75 were more likely to be given an LDL-C test (OR=1.56), while those over age 85 were less likely (OR=0.29) to receive a test. People within

the highest income quintile were more often given an LDL-C test than those in the lowest quintile (OR=1.50), and there appears to be a gradient from lowest to highest income quintile (but the odds ratios were not significant). Patients who lived in a non-urban setting were less likely to be given a test than patients who lived in an urban setting (OR=0.23). Finally, patients hospitalized for 11-30 days (OR=0.75) and over 31 days (OR=0.57) were less likely to be given an LDL-C test than those hospitalized 0-10 days.

The Hosmer and Lemeshow goodness-of-fit test had a p-value equal to 0.7813. This means that the null hypothesis (stating that the model fits) is not rejected. Therefore, this model seems to fit the data quite well.

4.3.5 Model for Being Given At Least One INR Test

Table 4.7 describes the statistically and clinically significant correlates for being given at least one INR test 2-12 months post-discharge in those taking warfarin.

Table 4.7: Statistically and clinically significant correlates for being given at least one INR test 2-12 months post-discharge in those taking warfarin

Correlates	Categories	Odds Ratio	95% Confidence Interval
Sex	Male	(ref)	(ref)
	Female	0.87	0.64-1.19
Age	18-74	0.95	0.68-1.32
	75-84	(ref)	(ref)
	85+	0.64	0.40-1.01
RHA of Residence	**04 Regina Qu'Appelle**	**1.80**	**1.32-2.46***
	06 Saskatoon	(ref)	(ref)
Urban/Non-Urban	Urban	(ref)	(ref)
	Non-urban	**0.20**	**0.14-0.28***
Multiple Stroke/TIA	Not a multiple stroke/TIA	(ref)	(ref)
	Multiple stroke/TIA	**1.99**	**1.07-3.70***

*** Statistically Significant**

As can be seen in Table 4.7, people who lived in a non-urban setting were less likely to be given an INR test than people who lived in an urban setting (OR=0.20). Patients who were included in the study population as a "multiple stroke" were more often given an INR test than those who had a "first stroke" (OR=1.99).

As illustrated in Table 4.7, the odds ratio for RHA is statistically significant for one of the two regions included. The reason there are only two regions was because laboratory data was

only available in the Saskatoon and Regina Qu'Appelle RHAs. Patients who lived in Regina Qu'Appelle (OR=1.80) were more likely to receive an INR test than those who lived in Saskatoon (reference).

The Hosmer and Lemeshow goodness-of-fit test had a p-value equal to 0.8457. This means that the null hypothesis (stating that the model fits) is not rejected, and that the model seems to fit the data.

4.3.6 Question Two Results Summary

While many of the same variables predict different outcomes related to secondary stroke prevention, the predictive model for each outcome varies, as seen in Table 4.8 and Table 4.9. These tables provide a complete synopsis of the logistic regression results.

Table 4.8: Statistically significant variables in models for drug-related secondary stroke prevention. Categories listed in table were significantly worse.

Variable	Model for Antihypertensive Medication	Model for Antilipidemic Medication	Model for Anticoagulant Medication
Main Effects			
Sex	X		
Age	X	Age 85+	Age 85+
RHA of Residence		Sun Country Regina Qu'Appelle	
Income Quintile		Lower Income	Lower Income
Urban/Non-Urban	Urban		
Hospital Category		District or Community Hospital	
Length of Stay			31+ Days
Multiple Stroke/TIA Previously on Drugs	Not previously on drugs	Not previously on drugs	Not previously on drugs
Interaction Terms			
Sex*Age	Males, Age 75+		

Table 4.9: Statistically significant variables in models for intermediate outcome secondary stroke prevention. Categories listed in table were significantly worse.

Variable	Model for LDL-C Tests	Model for INR Tests
Main Effects		
Sex	Female	
Age	Age 85+	
RHA of Residence		Saskatoon
Income Quintile	Lower Income	
Urban/Non-Urban	Non-Urban	Non-Urban
Hospital Category	N/A	N/A
Length of Stay	11-30 Days	
	31+ Days	
Multiple Stroke/TIA		Not a multiple stroke/TIA
Previously on Drugs	N/A	N/A

N/A = Not Applicable

4.4 Question Three: Geographical Variation in Secondary Stroke Prevention by Saskatchewan Regional Health Authority Areas

4.4.1 RHA Results and Logistic Contrasts for Medication Indicators

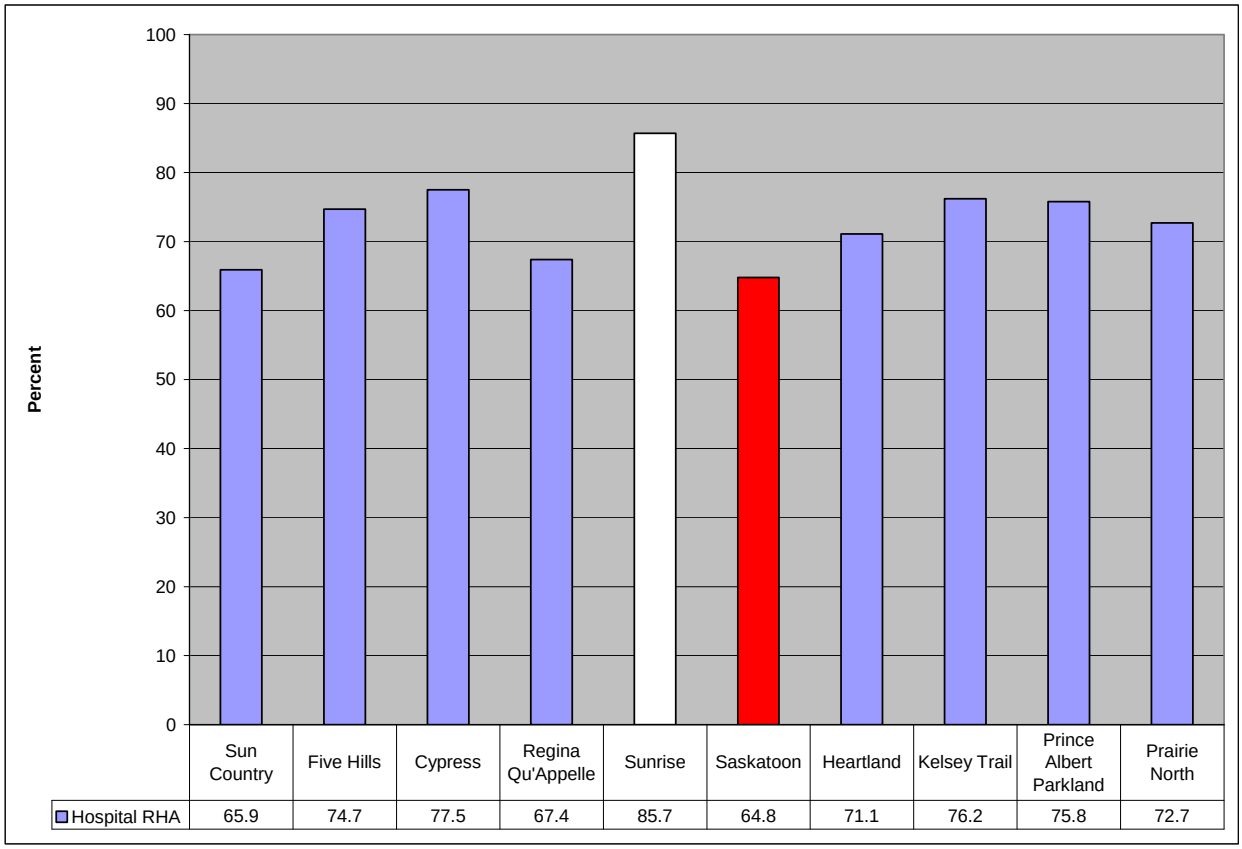
All results stratified for RHA (hospital or patient) for the medication indicators are presented within this section. The outcome (significantly better or worse) from the logistic contrast analyses are also presented within the RHA stratified figures. Due to the large number of results for RHA, only figures for the fiscal year 2007/08 are illustrated. Further, considering healthcare processes in the province, it is logical to present the 3-day medication indicators stratified by hospital RHA, and the 90-day medication indicators stratified by patient RHA.

4.4.1.1 Antihypertensive RHA Results

Figures 4.15 and 4.16 present the stratified RHA results for the antihypertensive indicators. Figure 4.15 shows the percentage of stroke/TIA patients on antihypertensives at 3 days by hospital RHA and fiscal year. The contrast analysis revealed that the Sunrise RHA, with a rate of 85.7%, was significantly better compared to the group of all other health regions, which had a rate of 68.9%. Conversely, the Saskatoon RHA, with a rate of 64.8%, was significantly worse compared to the rate of 72.8% in the group of all other health regions. Figure 4.16 illustrates the percentage of stroke/TIA patients on antihypertensives at 90 days by patient RHA and fiscal year. The contrast analysis again showed that the Sunrise RHA, with a rate of 73.4%,

was significantly better compared to the group of all other health regions, which had a rate of 62.8%.

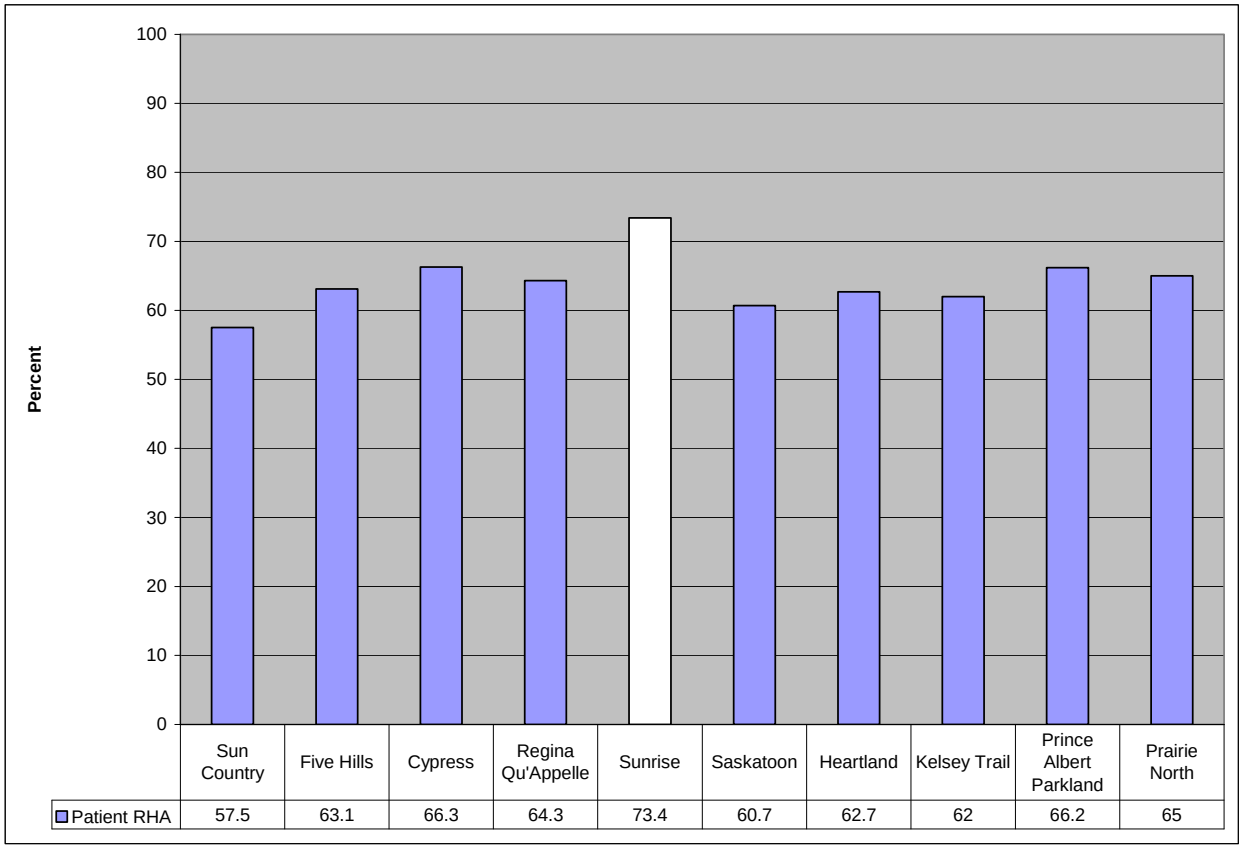
Figure 4.15: Percentage of stroke/TIA patients on antihypertensive medication at 3 days post-discharge, by hospital RHA



	Sun Country	Five Hills	Cypress	Regina Qu'Appelle	Sunrise	Saskatoon	Heartland	Kelsey Trail	Prince Albert Parkland	Prairie North
Hospital RHA	65.9	74.7	77.5	67.4	85.7	64.8	71.1	76.2	75.8	72.7

***Northern Saskatchewan not reportable due to small numbers**
WHITE – Significantly **better** than all other health regions combined
RED – Significantly **worse** than all other health regions combined

Figure 4.16: Percentage of stroke/TIA patients on antihypertensive medication at 90 days post-discharge, by patient RHA



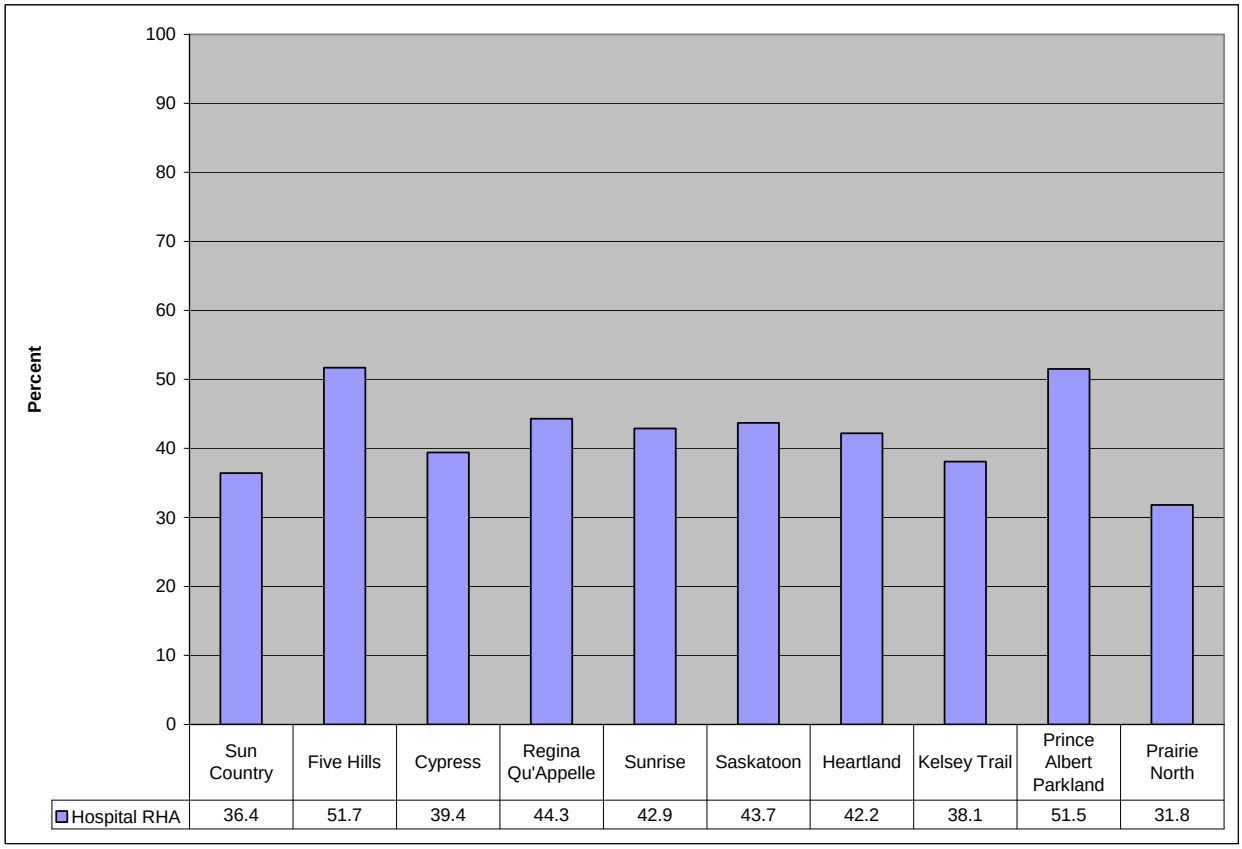
	Sun Country	Five Hills	Cypress	Regina Qu'Appelle	Sunrise	Saskatoon	Heartland	Kelsey Trail	Prince Albert Parkland	Prairie North
Patient RHA	57.5	63.1	66.3	64.3	73.4	60.7	62.7	62	66.2	65

***Northern Saskatchewan not reportable due to small numbers**
WHITE – Significantly **better** than all other health regions combined

4.4.1.2 Statin RHA Results

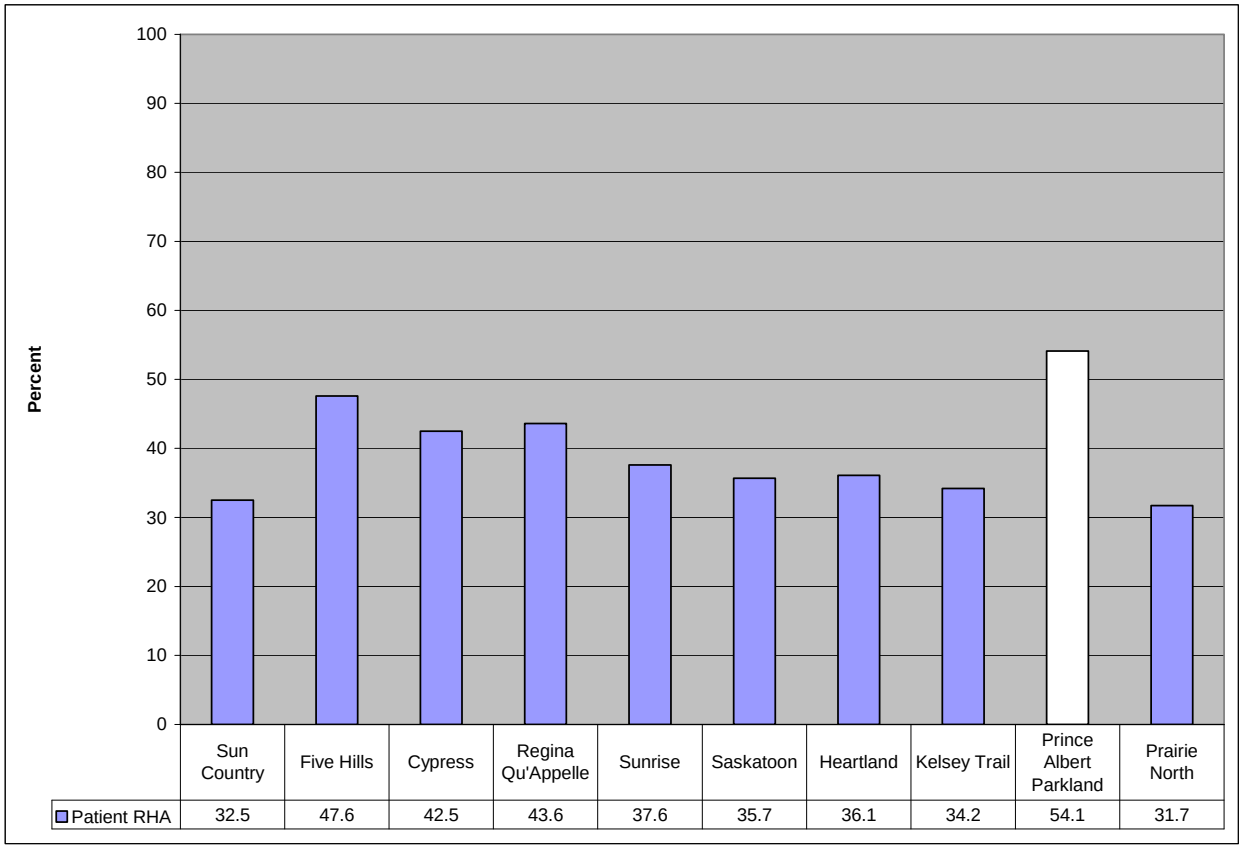
Figures 4.17 and 4.18 present the stratified RHA results for the statin (antilipidemic) indicators. In Figure 4.17, the percentage of stroke/TIA patients on statins at 3 days by hospital RHA and fiscal year can be seen. The contrast analysis revealed that there were no RHAs significantly better or worse than all others. Figure 4.18 illustrates the percentage of stroke/TIA patients on statins at 90 days by patient RHA and fiscal year. In this instance, the contrast analysis showed that the Prince Albert Parkland RHA, with a rate of 54.1%, was significantly better compared to the rate of 38.8% in the group of all other health regions.

Figure 4.17: Percentage of stroke/TIA patients on statin medication at 3 days post-discharge, by hospital RHA



***Northern Saskatchewan not reportable due to small numbers**

Figure 4.18: Percentage of stroke/TIA patients on statin medication at 90 days post-discharge, by patient RHA

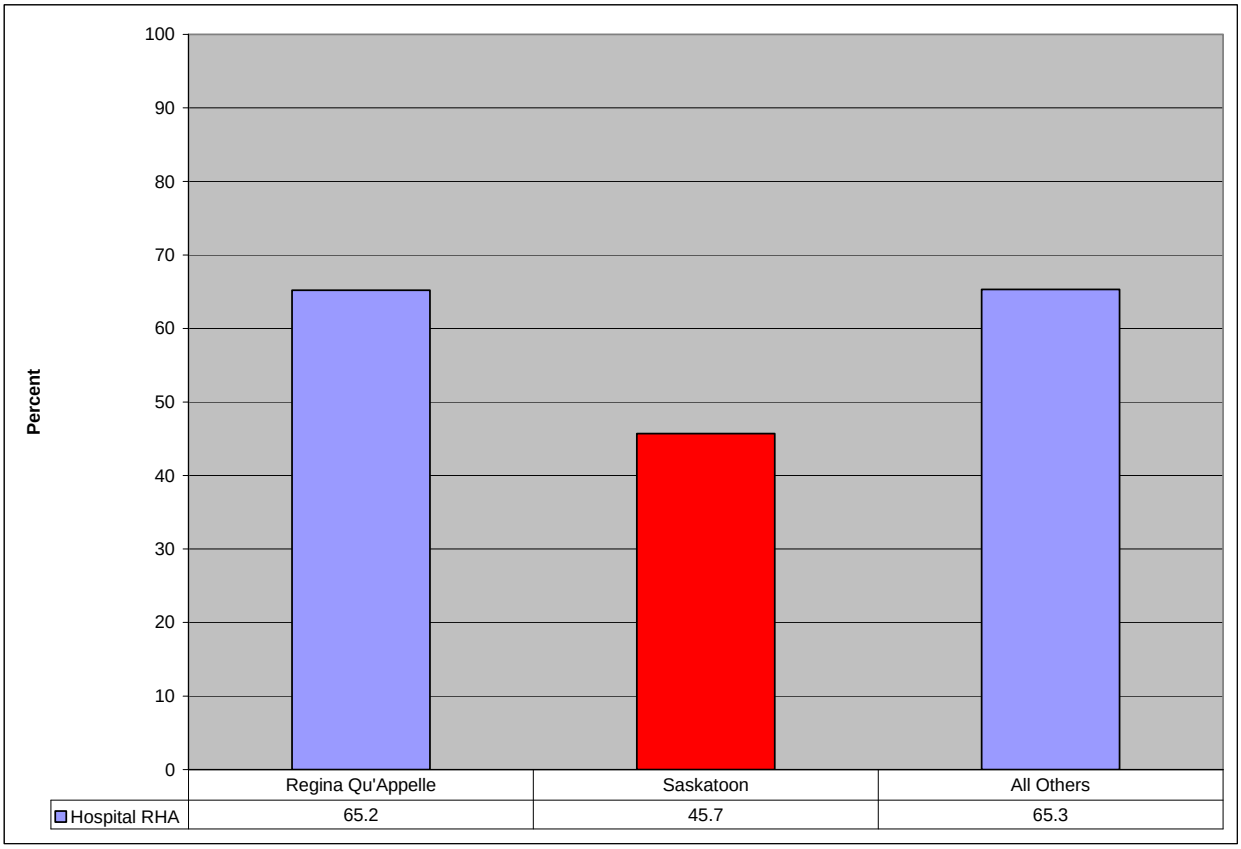


***Northern Saskatchewan not reportable due to small numbers**
WHITE – Significantly **better** than all other health regions combined

4.4.1.3 Anticoagulant RHA Results

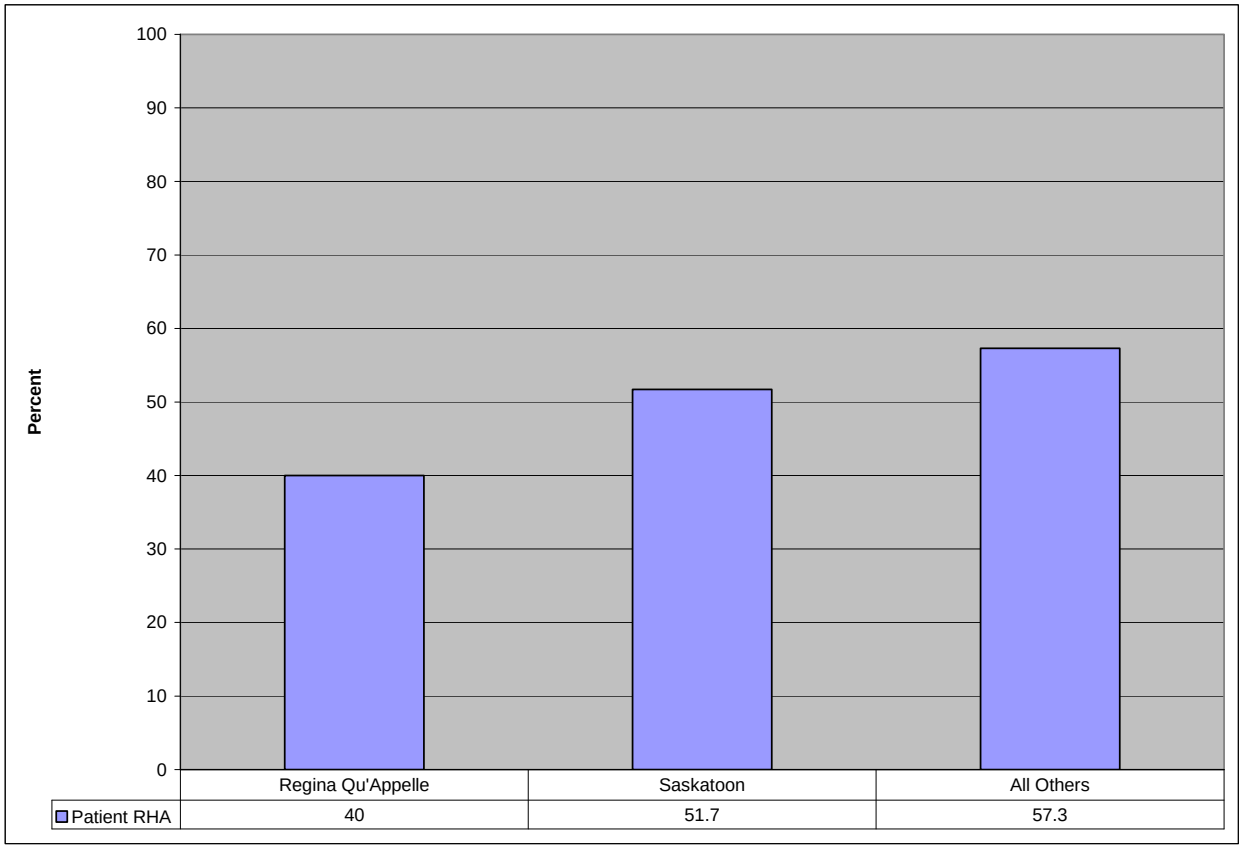
Figures 4.19 and 4.20 present the stratified RHA results for the anticoagulant indicators. Only stroke/TIA patients with atrial fibrillation were included. Due to the smaller number of patients, three RHAs were used for analysis – Saskatoon, Regina Qu'Appelle, and All Others. Figure 4.19 shows the percentage of stroke/TIA patients with atrial fibrillation on anticoagulants at 3 days by hospital RHA and fiscal year. The contrast analysis revealed that the Saskatoon RHA, with a rate of 45.7%, was significantly worse in having patients on anticoagulants at 3 days compared to the group with all other health regions combined (rate 65.3%). Figure 4.20 illustrates the percentage of stroke/TIA patients with atrial fibrillation on anticoagulants at 90 days by patient RHA and fiscal year. This time the contrast analysis showed that there were no RHAs significantly better or worse compared to the group with all others health regions combined.

Figure 4.19: Percentage of stroke/TIA patients with atrial fibrillation on anticoagulant medication at 3 days post-discharge, by hospital RHA



RED – Significantly **worse** than all other health regions combined

Figure 4.20: Percentage of stroke/TIA patients with atrial fibrillation on anticoagulant medication at 90 days post-discharge, by patient RHA



4.4.2 RHA Results for the Laboratory Test Indicators

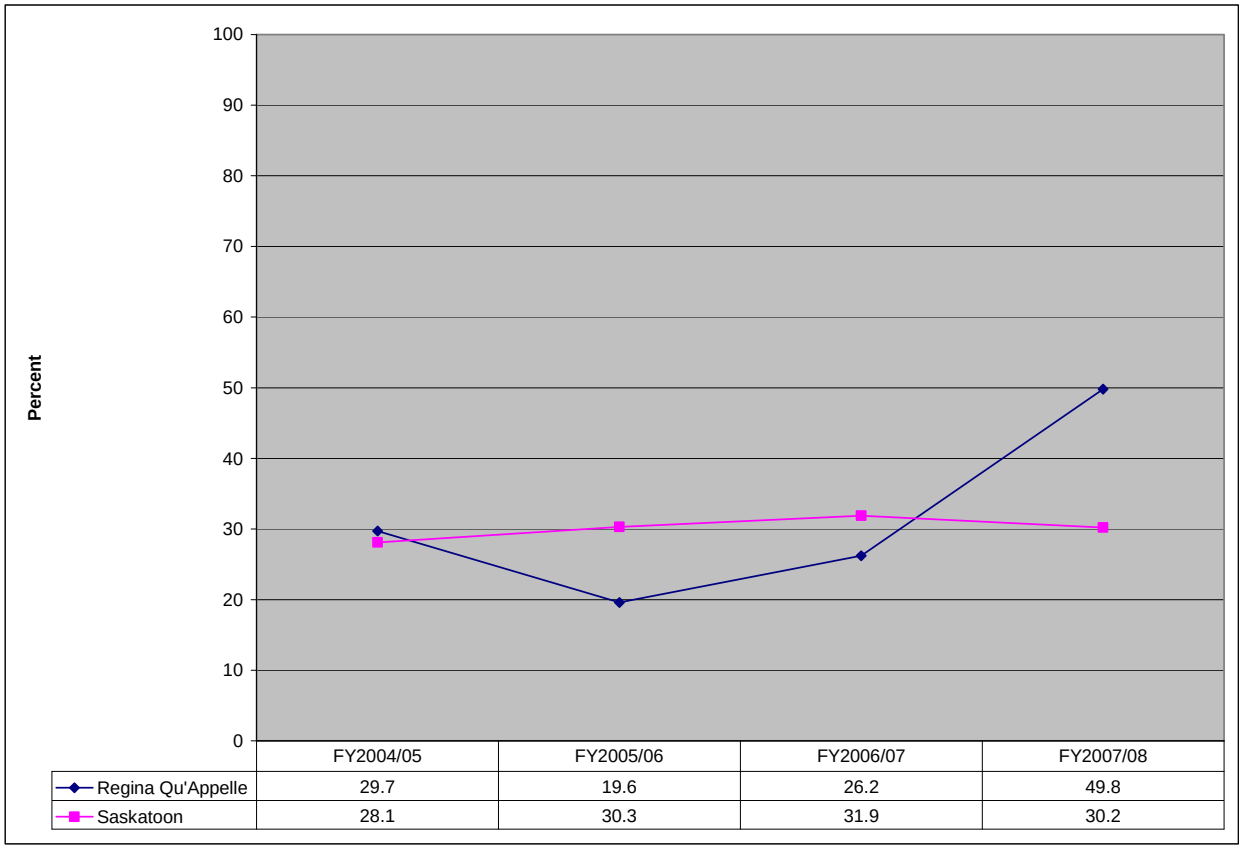
All results stratified for RHA (patient) for the laboratory test indicators are presented within this section. Considering laboratory data was only available for the Saskatoon and Regina Qu'Appelle RHAs, contrast analyses were not performed. Considering the timeframe of these indicators and the healthcare processes in the province, it is logical to present the results by patient RHA only.

4.4.2.1 LDL RHA Results

Figure 4.21 presents the stratified RHA results for LDL-C Test at 2-12 Months. The other indicator for LDL-C involved test results, which is subsequent to actually being given a test. Hence, the RHA results are presented for only the test indicator. The percentage of stroke/TIA patients given at least one LDL-C test 2-12 months post-discharge by RHA and fiscal year can be seen in Figure 4.21. Examining the results from the 2007/08 fiscal year, it is apparent that the Regina Qu'Appelle RHA is significantly better than the Saskatoon RHA in

giving patients an LDL-C test 2-12 months post-discharge. This is evident in how the confidence intervals do not overlap in the most recent fiscal year.

Figure 4.21: Percentage of stroke/TIA patients given at least one LDL-C test 2-12 months post-discharge, by patient RHA and fiscal year



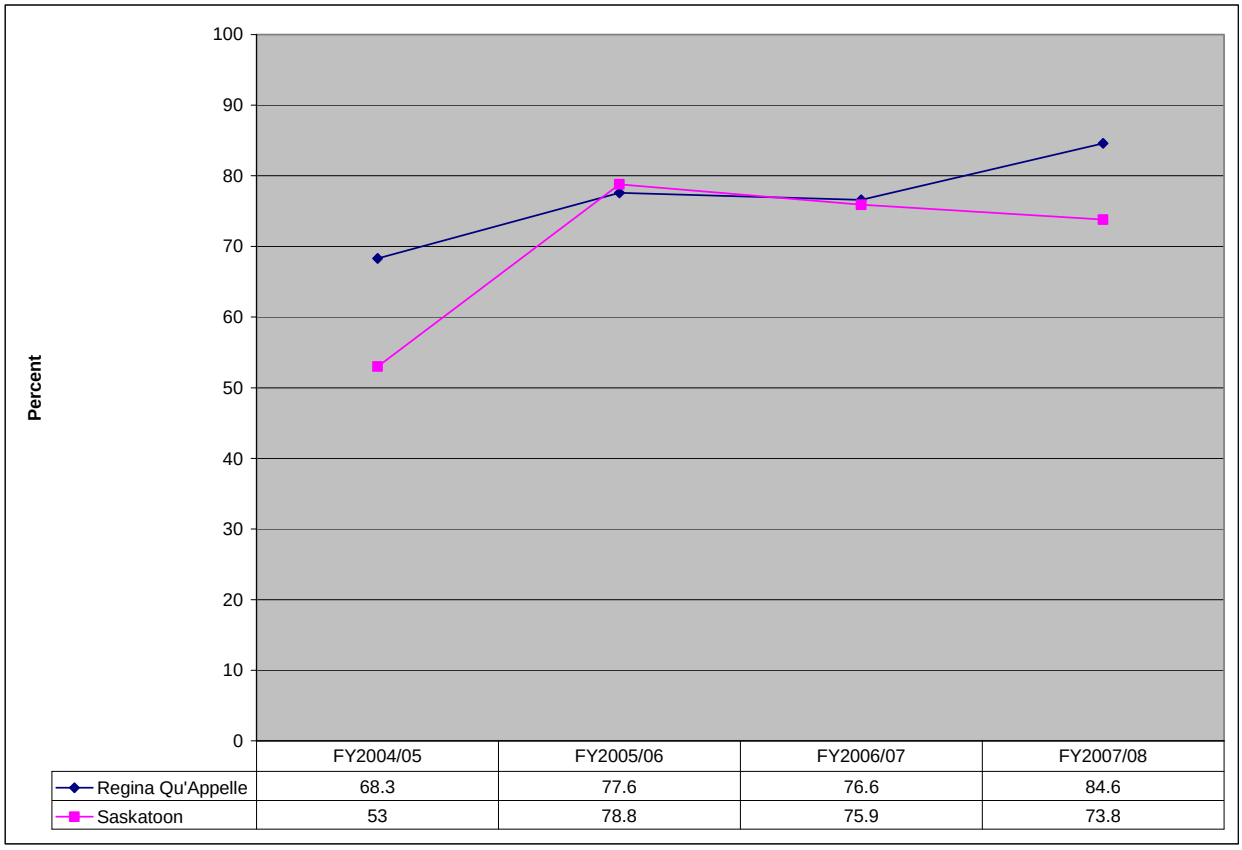
LDL 2-12		2004/05	2005/06	2006/07	2007/08
Regina Qu'Appelle	Percent	29.7	19.6	26.2	49.8
	95% CI	24.6-35.1	15.4-24.3	21.4-31.5	43.9-55.7
Saskatoon	Percent	28.1	30.3	31.9	30.2
	95% CI	23.1-33.5	25.4-35.7	26.6-37.5	25.1-35.7

4.4.2.2 INR RHA Results

Figure 4.22 presents the stratified RHA results for INR Test at 2-12 Months. The other indicators for INR involved test results, which is subsequent to actually being given a test. Hence, the RHA results are presented for only the test indicator. Stroke/TIA patients on warfarin at 3 or 90 days post-discharge were included. The percentage of stroke/TIA patients on warfarin given at least one INR test 2-12 months post-discharge by RHA and fiscal year can be seen in

Figure 4.22. It is apparent from the results that there is no statistically significant difference between the Regina Qu'Appelle and Saskatoon RHAs in the most recent fiscal year.

Figure 4.22: Percentage of stroke/TIA patients on warfarin at 3 or 90 days post-discharge given at least one INR test 2-12 months post-discharge, by patient RHA and fiscal year



INR 2-12		2004/05	2005/06	2006/07	2007/08
Regina Qu'Appelle	Percent	68.3	77.6	76.6	84.6
	95% CI	55.0-79.7	64.7-87.5	64.3-86.2	73.5-92.4
Saskatoon	Percent	53.0	78.8	75.9	73.8
	95% CI	41.7-64.1	68.6-86.9	65.3-84.6	63.1-82.8

4.4.3 Question Three Results Summary

To provide a brief review and synopsis of the results from the contrast analysis, the important points are presented below in condensed form.

In having patients on antihypertensive medication, the Sunrise RHA was better than the group of all others at both 3 and 90 days, while the Saskatoon RHA was worse at 3 days. The Prince Albert Parkland RHA was better than the group of all others at having patients on statins

at 90 days. The Saskatoon RHA was worse than the group of all others at having patients with atrial fibrillation on anticoagulants at 3 days. In the most recent fiscal year, the Regina Qu'Appelle RHA was better than the Saskatoon RHA at giving an LDL test to patients 2-12 months post-discharge. Finally, there was no difference between the Saskatoon RHA and Regina Qu'Appelle RHA in giving an INR test 2-12 months post-discharge in patients on warfarin.

CHAPTER 5: DISCUSSION AND CONCLUSIONS

5.1 Question One: Indicators of the Quality of Secondary Stroke Prevention

For all of the elements of secondary stroke prevention studied in this question, it was hypothesized that half or fewer of the patients discharged from Saskatchewan hospitals would receive the recommended care.

In interpreting the results for the medication-related indictors, it should be kept in mind that the "ideal" percentage on medication is not 100%. It is unrealistic to believe that 100% of stroke/TIA patients can be placed on the medications investigated in this study. This is because there are contraindications with the medication, as well as complications while taking the drug. If there is no stated benchmark, the ideal percentage in all medication indicators is considered to be "approaching 100%", keeping in mind that 100% can never be achieved.

Another thing to be kept in mind is that this study calculates quality indicators, not quality measures. Quality indicators measure how well a system is performing, and may point to potential problem areas that need further investigation (36). In order to identify the nature and extent of a problem, quality measures must be calculated (84). Quality measures, unlike quality indicators, are direct measures of clinical processes and reflective of evidence-based practice. In terms of the results of this study, the quality indicators portray on a macro level the quality of secondary stroke prevention in Saskatchewan using administrative data. In order to further investigate any identified problems at a micro or clinical level, quality measures need to be developed and calculated using clinical data.

One result that was similar for all medication indicators was the similarity of results between the 3 and 90 day calculations for all stroke/TIA. In all three medication types, there was only a small drop (<10%) in percentage of patients on medication at 90 days compared to 3 days. This drop can be expected due to complications with the medication, medication adjustment periods, and patient nonadherence (4, 76). However, the similarity of results at 3 and 90 days in all cases seems to signify that blood-pressure care, lipid-lowering care, and atrial fibrillation care in the hospital (as indicated by the 3-day results), and care in the primary setting (as indicated by the 90-day results) are fairly consistent in Saskatchewan.

As the rest of the results are specific to each indicator, they will be discussed separately.

5.1.1 Medication-Related Process of Care Indicators – Antihypertensive Medications

According to the Best Practice Recommendations, blood pressure lowering treatment should be initiated before discharge from hospital for all stroke/TIA patients (4). There is no current benchmark stating the proportion of patients who should be on antihypertensives (77).

As indicated by the study results it seems that, although there has been improvement over the study period, approximately 30-40% of stroke/TIA patients are not on antihypertensives at discharge. This percentage is a bit worse than results from Ontario, where approximately 25% of patients over 65 were not on antihypertensives at 90 days in 2005/06 (77). Similarly, in a study done in the United States, approximately 25% of patients were not on antihypertensives after admission to an inpatient rehabilitation facility (78). It is possible that stroke etiology is a factor in treatment since a lower percentage of hemorrhagic stroke patients were placed on antihypertensives at 3 days compared to all stroke/TIA. This is interesting considering it seems contraindicative that those with hemorrhagic stroke were less likely to be on antihypertensives bearing in mind the stroke etiology. Regardless, the proportion of patients who are not on medication is too large to be accounted for by this reason only.

Overall, it appears there is room for improvement in secondary stroke prevention in Saskatchewan in the area of blood pressure management. A higher proportion of stroke/TIA patients should be placed on antihypertensives at discharge from hospital and/or primary care to prevent the recurrence of stroke.

5.1.2 Medication-Related Process of Care Indicators – Antilipidemic (Statin) Medications

According to the Best Practice Recommendations, statin agents should be prescribed for most patients who have had an ischemic stroke or TIA; these medications have little effect in reducing hemorrhagic stroke (4). In addition, caution should be used in prescribing statins to patients who have had a hemorrhagic stroke and/or are at risk of bleeds (4, 52). There is no current benchmark stating the proportion of patients who should be placed on statins (77).

In examining the percentage differences between those who had an ischemic stroke/TIA and those who had a hemorrhagic stroke, it is apparent that there is a difference in treatment regime based on stroke etiology. This finding is consistent with the literature as there is still debate on the benefits/risks of prescribing statins to patients who had a hemorrhagic stroke (4, 52, 57, 58). It should be noted, however, that the lower percentage of hemorrhagic stroke patients taking statins does contribute to the overall finding that only about 40% of all

stroke/TIA patients are on antilipidemics at discharge. Regardless, the results show that, although there has been improvement, roughly 50-60% of all stroke/TIA patients are not being placed on statins at discharge. This percentage, though quite low, is fairly similar to results found in two Ontario studies (77, 79) as well as a Swedish study (80).

Currently, there seems to be a gap in secondary stroke care in the area of lipid management. It is apparent there is vast room for improvement in Saskatchewan in that a much higher number of ischemic stroke/TIA patients should be placed on statin medication at discharge from hospital and/or primary care.

5.1.3 Medication-Related Process of Care Indicators – Anticoagulant Medications

The Best Practice Recommendations state that patients who have atrial fibrillation who had an ischemic stroke/TIA should be treated with anticoagulants (4). There is no current benchmark stating the proportion of patients with atrial fibrillation who should be placed on anticoagulants (77).

As indicated by the study results, it seems that approximately 40-50% of stroke/TIA patients with atrial fibrillation are not being placed on anticoagulants at discharge. With this type of medication, however, there is a much higher chance for people having major contraindications such as recent bleeding (81, 82) rendering them unable to take anticoagulants. Some studies show that this is the case for up to a third of patients with atrial fibrillation (81, 82). Thus, the percentage not taking anticoagulants may be explained in part by both contraindications and complications with the medication. In spite of this, the approximate percentage of stroke/TIA patients with atrial fibrillation on warfarin over all fiscal years (approximately 52%) is not yet on par with similar results in Ontario (77, 79, 83), where approximately 70% of patients over age 65 were on warfarin at 90 days. These results suggest there is room for improvement in Saskatchewan.

Presently, it seems there is potential for some improvement in the area of atrial fibrillation management in secondary stroke prevention. A higher number of Saskatchewan stroke/TIA patients with atrial fibrillation should be prescribed anticoagulant medication at discharge from hospital. The percentages should increase to be on par with those in other provinces such as Ontario.

5.1.4 Laboratory Test Intermediate Outcome Indicators – LDL-C

According to the Best Practice Recommendations, adults at any age should have their blood lipids measured if they have a history of ischemic stroke or TIA (4). The recommended LDL-C target for stroke patient is <2.0 mmol/L (54).

In examining the study results, it seems that a large proportion of stroke/TIA patients living in the Saskatoon or Regina Qu'Appelle health regions (approximately 60%) are apparently not being given even one LDL-C test in the year following their discharge. Further to this, the majority of those given a test (approximately 60%) have an LDL-C level higher than recommended. Unfortunately, no other studies were found that had similar indicator calculations for comparison. One major reason for patients not receiving an LDL-C test may be non-adherence to physician recommendations. Receiving an LDL-C test involves fasting for 12 hours, commuting to a laboratory, and having blood drawn. Each of these requirements may influence a patient into non-adherence with the test because of discomfort and/or inconvenience. Another explanation may be due to the fact that information was not captured for any laboratory outside of the urban areas of Saskatoon and Regina. The other non-urban parts of these RHAs did not have information in the laboratory dataset. In other words, some patients who live in the non-urban parts of the RHAs (approximately 10%) may have had tests done in a laboratory outside of Saskatoon or Regina, but this information was not captured.

Regardless of the missing data, it is apparent that LDL-C testing needs to improve in stroke patients to help facilitate bringing lipid levels into the recommended range of <2.0 mmol/L. Given that lipid levels should be monitored in all persons who had a stroke (4), these results suggest a gap in lipid-lowering secondary stroke care in Saskatchewan.

5.1.5 Laboratory Test Intermediate Outcome Indicators – INR

The Best Practice Recommendations state that patients on warfarin medication require regular monitoring of blood levels to ensure they are within the target range 2.0-3.0 (4). The goal is to have all patients within the target INR range to reduce stroke risk as well as prevent complications from warfarin (4).

According to the study results, it appears that the majority of patients on warfarin are having at least one INR test in the year following discharge from stroke/TIA. It is, however, crucial for everyone taking warfarin to be tested due to the nature of the medication (4), and about 20% of patients are not receiving even one INR test. Furthermore, of those tested during

the 3, 6, and 12 month timeframes, only about half were in therapeutic range at any given month and fiscal year. In other words, half of the patients are not within the recommended INR range for those on warfarin. Unfortunately, no other province has the same exact indicator calculations for comparison. One possible reason patients on warfarin are not receiving an INR test may be due, again, to non-adherence with physician recommendations. An INR test involves commuting to a laboratory and having blood drawn, which may be inconvenient and/or uncomfortable. In addition, it is possible that physicians are not fully communicating the importance of getting regular INR tests to their stroke/TIA patients, meaning they have a lack of understanding. Also, patients may simply forget to go and have their INR test if they do not have a regular reminder from the physician. For these reasons, a patient may be non-adhering to physician recommendations. Another possible explanation may be that some patients are taken off warfarin due to complications. If this is the case, they likely do not need an INR test, but this information was not captured in the indicator calculation. A final reason may be because information was not captured for any laboratory outside of the urban areas of Saskatoon and Regina. The other non-urban parts of these RHAs did not have information in the laboratory dataset. In other words, some patients who live in the non-urban parts of the RHAs (approximately 25%) may have had tests done in a laboratory outside of Saskatoon or Regina, but this information would not have been captured.

In sum, it seems that Saskatchewan has improved in the last four years in terms of giving stroke/TIA patients on warfarin at least one INR test in the year post-discharge, but there is still much opportunity for betterment. Further, a higher proportion of patients should be within the target INR test range to prevent future complications.

5.2 Question Two: Correlates Associated with Receiving Secondary Stroke Prevention

For this question, it was hypothesized that there would be variations in quality of secondary stroke prevention related to such factors as age, gender, income, and urban/non-urban place of residence.

In the literature, there were a limited number of studies that have outlined factors associated with receiving secondary stroke prevention. The documented correlates include sex (67, 69, 70, 71), age (67), socioeconomic status (12, 72), and urban/non-urban place of residence (73).

5.2.1 Medication-Related Models

In the drug-related secondary stroke prevention models, only two variables were statistically significant in all three models: previously on drugs and age. Having been on the medication of interest before the stroke/TIA event meant a patient was more likely to be on medication following discharge. This is not surprising considering it is likely easier to continue taking a medication than it is to adhere to a newly prescribed one. In both the antilipidemic and anticoagulant models, patients over 85 were less likely to be on the medication compared to the age 75-84 reference group. In addition, the antilipidemic model showed that patients age 18-74 were more likely to be on the medication than the age 75-84 reference group. This finding that older patients are receiving less medication care is consistent with the literature that suggests the elderly need to be targeted for secondary prevention therapy (67, 76). The results of this study seem to reflect a greater need for secondary stroke prevention in elderly patients.

Income quintile achieved statistical significance in the antilipidemic and anticoagulant models. In both models, patients who were mid-range for income were more likely to be on the medication of interest than patients in the lowest quintile. The results are consistent with a previous study where socioeconomic status was weakly associated with various components of stroke care (12); the odds ratios were quite small with confidence intervals fairly close to the null value of 1.0. It is difficult to explain this finding. It is possible that how patients were assigned to a quintile was somewhat inaccurate as postal codes were the method of division; just because a person lives in a certain area of Saskatchewan does not necessarily mean they are in a specific income quintile.

Urban/Non-urban place of residence was statistically significant in the model for antihypertensive medications. A weak association was found indicating that patients who live in non-urban areas of Saskatchewan were more likely to be on medication than those the urban areas. This finding contradicts the study found on stroke care in urban and non-urban areas of the United States, which stated that acute stroke care in non-urban areas was suboptimal (73). This finding was surprising and unexplainable as there are generally more services available for health care (i.e. stroke care) in urban areas. Further studies need to be conducted to investigate this finding.

Hospital category was statistically significant in the model for antilipidemic medication. It was found that those discharged from a hospital categorized as district or community were less

likely to be on medication than those from a provincial hospital. An explanation for this might be that there are better protocols for secondary stroke prevention at provincial hospitals. It should be noted, however, that the relevance of this variable at 90 days post-discharge is likely minimal. At 90 days post-discharge, secondary stroke prevention should be the responsibility of the primary care physician, not the physicians at the patient's hospital of discharge. This variable would be more relevant in a model for 3-days post-discharge.

A patient's length of stay in the hospital was found to be significant for the anticoagulant model. If a stroke/TIA patient with atrial fibrillation was in hospital past 30 days, they were less likely to be on the medication at discharge. A possible explanation for this might be that patients who were in hospital longer had more complications from their stroke event, and thus were more likely to have a contraindication with anticoagulant medications.

Regional Health Authority (RHA) of residence was only statistically significant in the model for antilipidemic medications. Considering the differences in care between RHAs were investigated further using the logistic regression contrast model, the results will be discussed in that context (see Section 5.3.1).

Surprisingly, being a multiple stroke patient was not significant in any of the three models for drug-related secondary stroke prevention. It is logical to think that if a person had more than one stroke within two years that they would be more likely to be on secondary stroke prevention medications than a person who had a first stroke. However, it is apparent that this is not the case.

The sex*age interaction term was significant in only the model for antihypertensive medications. Females over the age of 75 were more likely than males of the same age to be placed on antihypertensive medications. In contrast, females under the age of 75 were less likely than males of the same age to be on antihypertensives. The results from this study are contradictory to most of the findings in the literature. In the limited studies done on sex differences in secondary stroke prevention, the results generally showed that women were less likely to receive various treatments than men (69, 70, 71). The reason for this difference may be due to what was being measured. In the referenced studies (69, 70, 71), they talk about a patient "receiving" medication; in other words, they explore the prescribing patterns of the physicians. This study, in contrast, explores the dispensing of medication to patients; in other words, whether or not the person is taking the drug of interest. The results are more in line with a Swedish study,

where they found that women were more likely to purchase some secondary prevention treatments than men (80). This study may have identified a difference in attitude towards treatment in older men and women; older men being less likely to adhere to physician orders. In order to more accurately explain this finding, however, a more in-depth study on gender differences in secondary stroke prevention needs to be carried out.

5.2.2 LDL and INR Intermediate Outcome Models

In the laboratory outcome secondary stroke prevention models, only one variable was statistically significant in both models: urban/non-urban place of residence. A patient living in a non-urban area was less likely to receive an LDL-C or INR test than a patient living in an urban area. This finding is not surprising, and can be explained by the fact that data was only available for the laboratories in the urban areas of the Saskatoon RHA and Regina Qu'Appelle RHA. Being that only people who live in the Saskatoon and Regina Qu'Appelle RHAs were included in the indicator calculations, there would be a limited number in the dataset from a non-urban area. Those who were, however, may have had their tests done in a laboratory that does not have information in this dataset. Therefore, the association found for a non-urban area may not be accurate due to missing information.

The correlates sex and age were significant for only the LDL-C test model. Interestingly, females were less likely to receive an LDL test than males. This is a surprising finding that is not easily explained. There, unfortunately, is nothing for literature regarding factors related to receiving LDL tests. Considering that the association is weak and the confidence interval for this model is fairly close to the null value of 1.0, the finding could be an anomaly with the stroke/TIA patient cohort. In terms of age, patients under the age of 75 were more likely to receive a test while those over 85 were much less likely. Again, there is not much for literature regarding factors related to receiving LDL tests, but these results are consistent with the medication-related literature that identifies a gap in secondary stroke prevention in the elderly (67, 76). A possible explanation for patients age 85+ not receiving an LDL test may be that they have other major health problems, and LDL-C levels are not a priority.

Income quintile achieved statistical significance in the LDL-C test model. Patients who were in the highest income quintile were more likely to have a test than those in the lowest quintile. These results are consistent with a previous study where socioeconomic status was weakly associated with various components of stroke care (12). It is possible that patients in the

highest income quintile were more easily able to access laboratory tests than those in the lowest quintile. As it appears there was a gradient from lowest to highest income quintile (though the odds ratios were not significant), the finding seems to be substantiated. It should be noted, however, that the significant odds ratio was not large.

A patient's length of stay in the hospital was found to be significant for the LDL-C test model. If a stroke/TIA patient was in the hospital past 10 days, they were less likely to receive an LDL-C test 2-12 months after discharge. A possible explanation for this might be that patients who were in hospital longer had more complications from their stroke event, and thus LDL levels were not a priority. Another possible reason might be that the patient received an LDL test while admitted to hospital. This information would not have been captured in the indicator.

Regional Health Authority (RHA) of residence was only statistically significant in the model for INR tests. For consistency in discussion, these findings will be reported along with the results from the logistic regression contrast model (see Section 5.3.2).

Finally, being a multiple stroke patient was associated with a higher likelihood of being given an INR test in those on warfarin. This finding is logical in that if a person has had more than one stroke in two years, they might be more likely to comply with physician recommendations and have their laboratory test completed. Again, there is no literature related to this type of laboratory indicator for comparison.

5.3 Question Three: Geographical Variation in Secondary Stroke Prevention by Saskatchewan Regional Health Authority Areas

For Question Three, it was hypothesized that there would be variation in secondary prevention between the different Saskatchewan Regional Health Authority Areas.

Statistically significant differences were found in the contrast model for some of the outcome variables in the study. These findings are discussed according to the medication-related or laboratory outcome indicators.

5.3.1 Medication-Related Indicators

Contrast models for each of the medication-related indicators were calculated at 3-days and at 90-days for hospital RHA and patient RHA respectively.

For hospital RHA at 3 days it was found that the Sunrise RHA was better than the group of all other RHAs at dispensing antihypertensives to patients at discharge from hospital. In

addition, the Saskatoon RHA was worse than the group of all other RHAs at dispensing both antihypertensives and anticoagulants at discharge. There are a couple potential reasons for these findings.

First, the Sunrise RHA may be better than the group of all other RHAs because of their methodology surrounding secondary stroke prevention. The RHA may have improved processes for ensuring that stroke/TIA patients receive the recommended antihypertensive care following a stroke event. Further, the physicians at the hospitals in the Sunrise RHA may simply be more inclined to prescribe antihypertensives at discharge than doctors in the other Saskatchewan RHAs.

A potential reason the Saskatoon RHA is significantly worse at dispensing both antihypertensives and anticoagulants at discharge could be due to the fact that sicker patients are admitted to the hospitals in this RHA. Because there is access to different types of care, patients are transferred to the hospitals in the Saskatoon RHA when care is unavailable or inadequate in their RHA of residence. In terms of dispensing antihypertensives, in sicker patients this simply may not be a priority. This explanation is certainly feasible taking into account the fact that at 3 days the Regina Qu'Appelle RHA (another RHA where patients are transferred) is not much better at dispensing antihypertensives than Saskatoon. Similarly, considering the likelihood of contraindications for anticoagulant use may be higher in sicker patients, it is possible that this is the reason the Saskatoon RHA came out worse than the group of all other RHAs.

It is interesting to note that the number of patients with atrial fibrillation on anticoagulants at 3 days in Saskatoon is about 20% lower than both the Regina Qu'Appelle RHA and the All Others RHA. This same difference is not seen at 90 days, and instead the Regina Qu'Appelle RHA has a lower percentage. These findings suggest that more research needs to be conducted to determine if there are differences between the RHAs for this anticoagulant indicator.

For patient RHA at 90 days, the Sunrise RHA was again better than the group of all other RHAs at dispensing antihypertensive medication. Moreover, the Prince Albert Parkland RHA was significantly better than the group of all other RHAs at dispensing statin medications. The explanation for both of these findings may again be explained by the fact that these RHAs may have improved processes, this time in the primary care setting, for secondary stroke prevention regarding medications. It could also be that primary care physicians in these areas are more

inclined to prescribe the medication, and/or are better at following up with the stroke/TIA patients.

5.3.2 LDL and INR Intermediate Outcome Indicators

Since the laboratory data was limited to the Saskatoon and Regina Qu'Appelle RHAs, differences between the regions will be discussed using the RHA figures (Section 4.4.2) and logistic regression results.

In examining the LDL-C test figure, the proportion of people given a test in the Saskatoon RHA has remained steady over the past four years at approximately 30%, while in Regina Qu'Appelle there was a large increase (approximately 25%) in the most recent year. Despite this, patient RHA was not a significant correlate in the model for LDL-C tests. The reason for this is likely because all of the fiscal years were included in the logistic regression model, not just the most recent year. In the years prior to FY2007/08, the Regina Qu'Appelle RHA actually seemed to have a smaller percentage of patients given an LDL test. Considering the result in the most recent fiscal year was significantly better in Regina Qu'Appelle than in Saskatoon, it seems that the Regina Qu'Appelle RHA may be improving the proportion of patients given an LDL-C test at a faster rate than the Saskatoon RHA. However, this inference cannot be drawn until data and results for more recent years are acquired.

The figure for the INR test indicator suggests that the Regina Qu'Appelle RHA is slightly, though not statistically, better at giving stroke/TIA patients on warfarin an INR test in the most recent year. This inference is consistent with the logistic regression results as the Regina Qu'Appelle RHA was found to be significantly better than the Saskatoon RHA at giving INR tests to patients on warfarin. These results may, again, simply imply that the Regina Qu'Appelle RHA has more quickly improved the proportion of patients on warfarin given an INR test compared to the Saskatoon RHA. However, as the results for both RHAs were very similar in fiscal years 2005/06 and 2006/07, data from more recent years is necessary to examine this potential change.

5.4 Study Strengths

While this study has shortcomings, there are strengths associated with the study design and methodology. First, this is a multi-year cross-sectional study, which by nature of the design has additional strengths than a traditional cross-sectional study. For instance, because cross-

sections of the stroke/TIA patient population in Saskatchewan were taken at seven time points during the study, potential changes in secondary stroke care could be identified, where in a regular cross-sectional study this is not possible.

The second major strength of this study is its use of the Saskatchewan Health Administrative Databases. This data contains a large amount of information on Saskatchewan patients that was collected without a specific goal, meaning the data is free of certain types of bias common with survey data (i.e. recall and selection bias). In addition, the data allowed for a large sample size in the study. This increases the probability that the sample population is representative of the general population in Saskatchewan.

Further, another strength of this study is the seven year ascertainment period for information on stroke/TIA patients. Being able to assess whether patients were taking medication at 3 and at 90 days post-discharge allowed time for people to fill their prescriptions. Only assessing at one point in time could result in an inaccurate portrayal of the proportion of patients on medication. Similarly, having the ability to acquire information about the medications people were taking before their stroke/TIA allowed for a more accurate assessment of the correlates associated with being on the various drugs.

Finally, this study was done in accordance with the standards set at the Health Quality Council (HQC). Following their guidelines and using previous work to develop the methodology has resulted in a high-quality study.

5.5 Study Limitations

As with all research, there are certain limitations to this study. Results must be considered with these in mind. Many of the issues arose from inherent limitations in both the administrative and laboratory data sources.

In the initial stages of this study, administrative data was only available to the end of the fiscal year 2007/08. It was therefore decided that all indicator calculations would occur up to this point. For this reason, stroke/TIA patients who had a stroke in the latter half of fiscal year 2007/08 often had to be eliminated from the 90-day indicator calculations as data for them was missing. This could potentially limit the clinical usefulness of this study as the most recent results are from two years ago. However, the results still give an overall indication of what has been happening in secondary stroke prevention in Saskatchewan.

As previously mentioned, drug information for Registered Indians was unavailable in the database. For consistency in the study, Registered Indians were left out of all analyses. Considering Registered Indians are an important portion of the Saskatchewan population and that their health needs are often different from the general population, it is unfortunate that secondary stroke prevention could not be explored within this subgroup.

Due to the fact that there are only a certain number and type of variables available in the administrative database, the correlates explored in the logistic regression models were also limited. For instance, it would have been beneficial to have a variable that more accurately portrayed a patient's socioeconomic status. The available income quintile variable is not a reliable indicator of socioeconomic status. By the same token, having a limited number of variables does not allow for a complete assessment of confounders. It is certainly possible that other variables might affect the results of the logistic models.

Accuracy of the coding for stroke patients with atrial fibrillation is questionable due to the small numbers that were found. Patients with this condition were identified by taking the stroke/TIA cohort, and finding any people that had a further diagnosis of atrial fibrillation. It is uncertain if all stroke/TIA patients with atrial fibrillation were coded as such in the database. This problem could have meant that some people with atrial fibrillation who had a stroke were missed in the pull from the database, causing a small number in the cohort. However, in a Swedish study that identified stroke patients with atrial fibrillation, it was found that 12% of all stroke/TIA patients had atrial fibrillation (80). This percentage is similar to the 13.5% identified in this study. This similarity seems to suggest that the coding is fairly accurate, but further investigation is required to ascertain that this is not a study limitation.

Initially, lab data sharing agreements were drawn up for the Saskatoon, Regina Qu'Appelle, and Sunrise RHAs. Unfortunately, data from the Sunrise RHA was not able to be acquired. Thus, the laboratory results and interpretation is limited to the Saskatoon and Regina Qu'Appelle RHAs. This also means that, in terms of laboratory outcomes, this study is not useful for the evaluation of the Saskatchewan Integrated Stroke Strategy. The evaluation team will likely have to collect their own data for the calculation of these specific laboratory indicators.

As previously discussed, information for the LDL and INR tests in the Saskatoon and Regina Qu'Appelle RHAs was limited to the laboratories located in the urban centers of

Saskatoon and Regina. This has obvious limitations in terms of interpretation. There were likely some patients included in the indicator calculations that did have an LDL or INR test done in the non-urban areas of the RHAs, but the information was not captured in the dataset. This could potentially have caused an underestimation of the number of patients who had at least one LDL or INR test within a year post-discharge.

It is important to note that the indicators calculated in this study are not directly applicable to the clinical practice of secondary stroke prevention. As with many patient care procedures, secondary stroke prevention measures given to stroke patients are based on the needs of the individual. This study calculated quality indicators (not quality measures) and the results are broad, meaning they are not focused on the individual patients or the specific nature of their stroke. Thus, the results of this study should not be interpreted to suggest that every stroke patient should receive the specific care recommended in the Canadian Stroke Strategy Best Practice Recommendations, as indirectly measured by the indicators in this study. Instead, the results provide an overall indication of the general nature of secondary stroke prevention in the province, and should be used as guidance for decisions at a population level regarding action to improve care for stroke patients in Saskatchewan.

5.6 Practical Implications of Results and Directions for Future Research

One of the major purposes of this study was to begin the development of an evaluation measurement system for the Saskatchewan Integrated Stroke Strategy (SISS) in the area of secondary stroke prevention. The methods and results from the medication-related indicators and models can be used directly by the SISS for this purpose. Since laboratory data was inaccessible for the Sunrise RHA, there unfortunately are no results for the laboratory indicators and models. However, the proper methods for calculation of these indicators are laid out in this study, and when data becomes available the SISS will be able to follow the methodology and quickly acquire results.

In order to improve secondary stroke prevention in Saskatchewan, it is first essential to know how the province is performing in this area of care. This is the first study of its kind in Saskatchewan examining areas of secondary stroke prevention. In terms of the calculated indicators, the study found that medication-related and laboratory outcome secondary stroke prevention is generally sub-optimal across the province. The results suggest that improvements in these areas need to be made to prevent recurrent strokes in Saskatchewan residents. The SISS

is a great starting point for making the necessary changes in the province, and the hope is that all other RHAs will be able to follow suit in the near future. To ascertain if changes in secondary stroke prevention have been beneficial, it will be important to have a regular assessment of these prevention areas. A future study in this area might involve investigating whether the processes put in place for secondary stroke prevention have impacted the outcome – especially the proportion of people who experience recurrent stroke.

While the results from the indicators are quite clear, there are certainly many avenues for future studies in secondary stroke prevention in Saskatchewan. Considering that this study found there were differences in treatment between all stroke/TIA and hemorrhagic stroke, a future study is needed to examine the full extent and meaning of these variations. These differences also point out the need for more detailed clinical investigations about the appropriateness of stroke secondary prevention at the level of individual patients and care providers, since a precise, localized evaluation of quality of care will depend on many factors not well captured in administrative health data, such as the stroke etiology and comorbidities of individual stroke patients.

Unfortunately, an important sub-population in Saskatchewan was not represented in this study because information on medication use was missing for Registered Indians. The feasibility of acquiring this information in future is currently unknown as there are still barriers with both obtaining the data, as well as linking it with provincial information. However, progress is being made, and in future the hope is that a study can be done examining secondary stroke prevention within this important subpopulation of the province.

This study also found some evidence of differences in the provision of secondary stroke prevention based on certain correlates. While this information is important for the province to recognize, additional studies are required to examine these potential differences at a finer level of detail.

In examining the secondary stroke prevention areas within the separate Saskatchewan RHAs, it was found that some RHAs were better or worse compared to all others in the province. These regional differences should be further examined by the province to determine their validity and magnitude, as well as ensure that all residents are receiving the same level of care regardless of where they live in Saskatchewan. More importantly though, given that the differences

between the RHAs were not large, the results seem to suggest that there is a need for a province-wide initiative to overall improve secondary stroke prevention in Saskatchewan.

While this study was able to take a snap-shot of secondary stroke prevention in the province, it was not able to answer the more meaningful questions "Why is secondary stroke prevention sub-optimal in the province" and "How can secondary stroke prevention be improved within the health care system?". The SISS is designed to address these questions, and having the information from this study will given them a starting place for important discussions. It is clear, however, that future studies and discussions within the health care system need to take place in order to improve secondary stroke prevention in Saskatchewan.

5.7 Conclusions

While specific areas of secondary stroke prevention were examined in this study, it is apparent that future research needs to be conducted in this area. This study described what is currently happening in Saskatchewan secondary stroke prevention, but it was not able to explain why, or how improvements could be made. Regardless, the results serve as a baseline for evaluation of the impact of the Saskatchewan Integrated Stroke Strategy in the area of secondary stroke prevention.

Using the guidelines and performance measures from the Canadian Stroke Strategy (4, 5), this study was able to conclusively show that secondary stroke prevention in the province is sub-optimal in the management of hypertension, dyslipidemia, and atrial fibrillation. It also identified that there may be differences in provision of care based on various factors such as age and income. Finally, evidence was found suggesting that there may be variations in care between regional health authorities. These findings indicate that there is a need for further studies in this area, and that improvements need to be made in secondary prevention to help stroke patients in Saskatchewan avoid the devastation of a recurrent stroke event.

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APPENDIX A: SASKATCHEWAN HEALTH ADMINISTRATIVE DATABASES

List of the Saskatchewan Health Administrative Databases and the variables abstracted from each dataset

Dataset	Basic Description	Key Variables Used
Person Registry System (PRS)	A registry system tracking Saskatchewan residents eligible for health benefits	• Health Services Number (HSN) (encrypted) • Age • Sex • Registered Indian status • Coverage effective date • Coverage expiry date • Coverage expiry reason
Geographical Information File (GEO)	Statistics Canada data linked to de-identified PRS data by Saskatchewan Health	• HSN (encrypted) • Urban residence indicator • Income quintile (geographic average) • RHA where resident lives
Prescription Drug Plan Historical Claims (PDP)	Database of drug prescriptions dispensed	• HSN (encrypted) • Drug identification number (DIN) • Date of dispensing • Pills dispensed
Prescription Drug Plan – DIN File	DINs and drug categories for each prescription drug	• Drug identification number (DIN) • Generic name of drug • Strength of drug • Dosage • Form of drug
Vital Statistics (VS)	Births and deaths	• HSN (encrypted) • Date of death
Hospital Discharge Abstract Database (DAD)	Hospital discharges	• HSN (encrypted) • Date of admission • Date of discharge • Diagnosis Codes (ICD-10-CA) • Hospital name • Hospital category

Dataset	Basic Description	Key Variables Used
Physician Services Claims File: Medical Services Branch (MSB)	Physician services fee claims	• HSN (encrypted) • Provider MSB number (encrypted) • Date of service • Number of services • Type of service or major group code • Diagnosis Codes (ICD-9 or MSB)

APPENDIX B: RESEARCHER DOCUMENTATION

Complete researcher documentation as used in all HQC analyses

Steps		Criteria	Rationale	Date: Added
Common Criteria #1. Step 1. Identify stroke/TIA patient cohort				
These criteria define the denominator for the indicators				
A separate file must be created for each fiscal year, 01/02 to 07/08				
1	**a**	All those who experienced a stroke or TIA and admitted to hospital between April 1, 2001 and March 31, 2008, inclusive Use ICD-10-CA codes (note: no IDC-9 codes because using data after 2001) (see Section 3.4.1 of thesis document) Keep all records that have any of the following in the first diagnosis code (most responsible diagnosis): I60, I61, I64, G450, G451, G452, G453, G458, G459, H341, I630, I631, I632, I633, I634, I635, I638, I639, I676	The purpose of the study is to gain an understanding of condition management with drugs in secondary stroke prevention. In order to do so, patients who have experienced a stroke or TIA need to be identified. The dates were chosen according to availability of data and consistency in coding. All strokes are important, and therefore all included for now – will subset later according to indicator.	
	b	Two denominator groups: Group 1: All stroke and TIA Create flags for stroke and TIA 1 = stroke 1 = TIA 0 = no stroke 0 = no TIA Create group using flags Group 2: Only stroke Create flag for stroke 1 = stroke 0 = no stroke Create group using flags	Reason for two groups is to capture what happens when TIA is included/excluded in the indicators.	

Steps		Criteria	Rationale	Date: Added
	c	Link episodes of care (EOC) so that all transfers and nests are included within the same EOC Note: The EOC started with a primary Dx of stroke in ALL cases. Anything that happened following the stroke (ie. rehab) was also included in the EOC.	Only want to count each stroke once, not more than once if, for instance, they transfer hospitals. If episodes following the stroke Dx are NOT included, it may create an absence of drug care (because of hospital stay), when really none exists. In data exploration it was found that the average length of stay (los) was increased for approx. 3000 patients when the episodes following stroke were included. This change was significant and had the potential to impact the results. Therefore, this "extended EOC" was used for the study.	
	d	All those who were ≥ age 18 on the date of their stroke or TIA	By setting the minimum age at 18, most of the stroke events will be captured. Also, this is the age of adulthood in Canada.	
	e	All those who were hospitalized within the province (must permanently delete all out of province cases)	The study involves stroke care in Saskatchewan, and thus residents who were hospitalized elsewhere need to be excluded.	
	f	All those who had valid Saskatchewan Health Insurance coverage: • For those that die within the fiscal year of their stroke, must have coverage from last discharge date to service date (3 and/or 90 days)	Must be covered for time period of interest (last discharge date to service date). Using the "service date" means that the reporting is based on the assessment date for a service (in this case, assessment for drugs). If no coverage, the person may have died or moved out of province. In either case, they should not be included in the cohort.	

Steps		Criteria	Rationale	Date: Added
	g	All individuals with information on sex and DOB	Such information is necessary for proper data analysis, and thus where information is missing the individuals need to be excluded. Assume day 15 of a given month for DOB because dataset does not include birth day. This assumes an even distribution of birth days over a month.	
	h	All individuals who are not Registered Indians	Individuals with Registered Indian status were identified and excluded since their prescription drugs are covered by the federal government and are not (consistently) captured in the provincial Prescription Drug Plan Historical Claims dataset.	
	i	All individuals who have drug information in drug file	Because the purpose of the study is to examine drug dispensing patterns, residents without drug data need to be excluded (presumably because their prescription drugs are covered federally or they did not require any prescriptions during the course of the study).	
	j	All individuals who survived their stroke or TIA event to the referent "service date" for each indicator	The purpose of the study is to examine secondary stroke care, and this is nonexistent in individuals who did not survive their stroke event.	
	k	Create flags for ischemic and hemorrhagic stroke: Ischflag: 1 = ischemic stroke 0 = other stroke Hemorrflag: 1 = hemorrhagic stroke 0 = other stroke	Need to be able to distinguish between stroke types for later calculations as the etiology and treatments for each may vary.	

Steps		Criteria	Rationale	Date: Added
	l	Create fiscal year flags for service reporting. This will include: • Year at admission • Year at 3-day post discharge • Year at 90 day post discharge	"Service Date" refers to the case where reporting is based on the assessment date for a service. In this study, the reporting is based on the assessment for drugs at 3 and 90 days following discharge for a stroke/TIA.	
	m	Create length of stay (los) variable: last discharge date – first admit date	This variable is needed for analysis using logistic regression as it may be an important determinant in receiving secondary stroke care.	
	n	Create a flag to identify the people in the data set who have had more than one stroke/TIA. To be a multiple stroke the person had to have another stroke/TIA within two years of the first one in the data set (2-year washout period 2001/02, 2002/03) Pts_multi: 1 = multiple stroke 0 = not multiple stroke	It is important to identify the people in the dataset who have had more than one stroke/TIA episode as this may be a determinant of their secondary stroke care (ie. they may already be on the necessary drugs because of their first stroke/TIA episode).	
		Create 3-day and 90-day denominators; Create Atrial Fibrillation denominators		
DRUG DENOMINATORS				
3-Day Drug Denominator ( )				
2	**a**	• Common Criteria #1		
	b	Alive at 3 days post-discharge	The purpose of the study is to examine secondary stroke care, and this is nonexistent in individuals who did not survive their stroke event to the service date of interest.	

Steps		Criteria	Rationale	Date: Added
	c	Coverage is defined by: • Covered from last discharge date to last discharge date+3	Must be covered for time period of interest (last discharge date to service date). Using the "service date" means that the reporting is based on the assessment date for a service (in this case, assessment for drugs at 3 days post-discharge). If there is no coverage during this time period, the person may have died or moved out of province. In either case, they should not be included in the cohort.	
	d	RHA is defined by: • 1) Where the patient is living at the 3rd day after discharge for stroke • 2) The RHA of the last hospital of discharge for the patient • If no rha exists in this time period, patient excluded	People with missing RHA information will be excluded from analysis ONLY on the RHA variable.	
	e	All individuals who are within the outlined fiscal years (2001/02 – 2007/08) at 3 days post-discharge.	Because this indicator is 3 days after discharge from stroke, the fiscal year for the individual may have been pushed into 2008/09 and therefore come up as "missing". As there is no information for these individuals, they had to be excluded from the cohort.	
90-Day Drug Denominator ()				
3	**a**	• Common Criteria #1		
	b	Alive at 90 days post-discharge	The purpose of the study is to examine secondary stroke care, and this is nonexistent in individuals who did not survive their stroke event to the service date of interest.	

Steps		Criteria	Rationale	Date: Added
	c	Coverage is defined by: • Covered from last discharge date to last discharge date+75	The 15th day before the indicator reference date was chosen because the lowest number of pills dispensed (rare exceptions) was 15 pills. Thus, as long as the patients were covered 15 days before the assessment date, it can be said that the prescription lasted 15 days, and that they had sufficient drugs to be taking it on the assessment date.	
	d	RHA is defined by: • 1) Where patient is living at the 90th day after discharge for stroke • 2) The RHA of the last hospital of discharge for the patient • If no rha exists in this time period, patient excluded	People with missing RHA information will be excluded from analysis ONLY on the RHA variable.	
	e	All individuals who are within the outlined fiscal years (2001/02 – 2007/08) at 90 days post-discharge.	Because this indicator is 90 days after discharge from stroke, the fiscal year for the individual may have been pushed into 2008/09 and therefore come up as "missing". As there is no information for these individuals, they had to be excluded from the cohort.	
Atrial Fibrillation 3-Day Drug Denominator ()				
4	**a**	• Common Criteria #1		
	b	• 3-Day Drug Denominator criteria		
	c	Diagnosis of atrial fibrillation on hospital discharge record. ICD10-CA code: I480 Create flag for atrial fibrillation: Afib: 1 = atrial fibrilation 0 = no atrial fibrillation Keep all records where afib=1.	The purpose of one of the indicators is to gain an understanding of condition management with drugs in secondary stroke prevention in those with atrial fibrillation. In order to do so, patients who have atrial fibrillation need to be identified.	
Atrial Fibrillation 90-Day Drug Denominator ()				

Steps		Criteria	Rationale	Date: Added
5	**a**	• Common Criteria #1		
	b	• 90-Day Drug Denominator criteria		
	c	Keep all records where afib=1.		
DRUG NUMERATORS				
Common Criteria #2. Drug Numerators.				
These criteria define the numerators for the drug indicators				
6	**1**	For the drug lists created by the pharmacotherapy consultant, pull all DIN numbers from ALL the alldin files from SK Health		
	2	For HSN's resulting from Common Criteria #1 and the appropriate denominator definition (or at least Common Criteria #1): • Pull all prescriptions for the DIN's found from step 6.1, from all the drug claims of the years of interest		
	a	For HSN's resulting from Common Criteria #1 and the appropriate denominator definition (or at least Common Criteria #1): • Pull ALL hospital records from the most recent EOC file		
Statinflag3				
7	**1**	• Common Criteria #2		
	2	Using drug rule 4: =1 if patient is on Statin medication (combination of any DINs that are statins) 3 days after discharge **Assumed lowest frequency: 1** Hospitalization days must be accounted for.	**See Appendix F - Explanation of Drug Rule 4** Drugs in hospital do not show up on the drugs claims files. If a patient is hospitalized, it may be that their Rx that was filled before the hosp will not be used up at the expected time because of free drugs.	
Lipstatflag3				
8	**1**	• Common Criteria #2		

Steps		Criteria	Rationale	Date: Added
	2	Using drug rule 4: =1 if patient is on ANY antilipidemic medication (combination of any DINs that are antilipidemics) 3 days after discharge **Assumed lowest frequency: 1** Hospitalization days must be accounted for.	**See Appendix F - Explanation of Drug Rule 4** Drugs in hospital do not show up on the drugs claims files. If a patient is hospitalized, it may be that their Rx that was filled before the hosp will not be used up at the expected time because of free drugs.	
ACEIflag3				
9	**1**	• Common Criteria #2		
	2	Using drug rule 4: =1 if patient is on ACEI medication (combination of any DINs that are ACEIs) 3 days after discharge **Assumed lowest frequency: 1** Hospitalization days must be accounted for.	**See Appendix F - Explanation of Drug Rule 4** Drugs in hospital do not show up on the drugs claims files. If a patient is hospitalized, it may be that their Rx that was filled before the hosp will not be used up at the expected time because of free drugs.	
Antihypflag3				
10	**1**	• Common Criteria #2		
	2	Using drug rule 4: =1 if patient is on ANY antihypertensive medication (combination of any DINs that are antihypertensives) 3 days after discharge **Assumed lowest frequency: 1** Hospitalization days must be accounted for.	**See Appendix F - Explanation of Drug Rule 4** Drugs in hospital do not show up on the drugs claims files. If a patient is hospitalized, it may be that their Rx that was filled before the hosp will not be used up at the expected time because of free drugs.	
Warfarinflag3				
11	**1**	• Common Criteria #2		
	2	Using drug rule 4: =1 if patient is on warfarin medication (combination of any DINs that are warfarin) 3 days after discharge **Assumed lowest frequency: 1** Hospitalization days must be accounted for.	**See Appendix F - Explanation of Drug Rule 4** Drugs in hospital do not show up on the drugs claims files. If a patient is hospitalized, it may be that their Rx that was filled before the hosp will not be used up at the expected time because of free drugs.	
Anticoflag3				
12	**1**	• Common Criteria #2		

Steps		Criteria	Rationale	Date: Added
	2	Using drug rule 4: =1 if patient is on ANY anticoagulant medication (combination of any DINs that are anticoagulants) 3 days after discharge **Assumed lowest frequency: 1** Hospitalization days must be accounted for.	**See Appendix F - Explanation of Drug Rule 4** Drugs in hospital do not show up on the drugs claims files. If a patient is hospitalized, it may be that their Rx that was filled before the hosp will not be used up at the expected time because of free drugs.	
Statinflag90				
13	**1**	• Common Criteria #2		
	2	Using drug rule 4: =1 if patient is on Statin medication (combination of any DINs that are statins) 90 days after discharge **Assumed lowest frequency: 1** Hospitalization days must be accounted for.	**See Appendix F - Explanation of Drug Rule 4** Drugs in hospital do not show up on the drugs claims files. If a patient is hospitalized, it may be that their Rx that was filled before the hosp will not be used up at the expected time because of free drugs.	
Lipstatflag90				
14	**1**	• Common Criteria #2		
	2	Using drug rule 4: =1 if patient is on ANY antilipidemic medication (combination of any DINs that are antilipidemics) 90 days after discharge **Assumed lowest frequency: 1** Hospitalization days must be accounted for.	**See Appendix F - Explanation of Drug Rule 4** Drugs in hospital do not show up on the drugs claims files. If a patient is hospitalized, it may be that their Rx that was filled before the hosp will not be used up at the expected time because of free drugs.	
ACEIflag90				
15	**1**	• Common Criteria #2		
	2	Using drug rule 4: =1 if patient is on ACEI medication (combination of any DINs that are ACEIs) 90 days after discharge **Assumed lowest frequency: 1** Hospitalization days must be accounted for.	**See Appendix F - Explanation of Drug Rule 4** Drugs in hospital do not show up on the drugs claims files. If a patient is hospitalized, it may be that their Rx that was filled before the hosp will not be used up at the expected time because of free drugs.	
Antihypflag90				
16	**1**	• Common Criteria #2		

Steps		Criteria	Rationale	Date: Added
	2	Using drug rule 4: =1 if patient is on ANY antihypertensive medication (combination of any DINs that are antihypertensives) 90 days after discharge **Assumed lowest frequency: 1** Hospitalization days must be accounted for.	**See Appendix F - Explanation of Drug Rule 4** Drugs in hospital do not show up on the drugs claims files. If a patient is hospitalized, it may be that their Rx that was filled before the hosp will not be used up at the expected time because of free drugs.	
Warfarinflag90				
17	**1**	• Common Criteria #2		
	2	Using drug rule 4: =1 if patient is on warfarin medication (combination of any DINs that are warfarin) 90 days after discharge **Assumed lowest frequency: 1** Hospitalization days must be accounted for.	**See Appendix F - Explanation of Drug Rule 4** Drugs in hospital do not show up on the drugs claims files. If a patient is hospitalized, it may be that their Rx that was filled before the hosp will not be used up at the expected time because of free drugs.	
Anticoflag90				
18	**1**	• Common Criteria #2		
	2	Using drug rule 4: =1 if patient is on ANY anticoagulant medication (combination of any DINs that are anticoagulants) 90 days after discharge **Assumed lowest frequency: 1** Hospitalization days must be accounted for.	**See Appendix F - Explanation of Drug Rule 4** Drugs in hospital do not show up on the drugs claims files. If a patient is hospitalized, it may be that their Rx that was filled before the hosp will not be used up at the expected time because of free drugs.	
LABORATORY INDICATORS				
LABORATORY DENOMINATORS - LDL				
LDL 2-4 Month Denominator				
19	**a**	• Common Criteria #1		
	b	• 90-Day Drug Denominator criteria	Since the indicator is at "3 months post-stroke", those who died before 3 months should not be included in the denominator, and therefore this dataset was utilized.	

Steps		Criteria	Rationale	Date: Added
	c	All individuals who live in the Saskatoon or Regina Qu'Appelle RHA. Keep rha=4 or rha=6	Laboratory data was only available for these RHAs. Thus, to make the indicator calculation correct, people who live outside of RHA 4 or 6 needed to be excluded from the denominator.	
LDL 2-12 Month Denominator				
20	**a**	• Common Criteria #1		**20**
	b	• 90-Day Drug Denominator criteria	Since the indicator is at "3 months post-stroke", those who died before 3 months should not be included in the denominator, and therefore this dataset was utilized.	
	c	All individuals who live in the Saskatoon or Regina Qu'Appelle RHA. Keep rha=4 or rha=6	Laboratory data was only available for these RHAs. Thus, to make the indicator calculation correct, people who live outside of RHA 4 or 6 needed to be excluded from the denominator.	
LDL Test Result Indicator Denominator				
21	**a**	• LDL 2-12 Month Denominator criteria		
	b	Merge the 90-Day Drug Denominator key_hsns with the current laboratory data file(s).		
	c	Create flag for those who had an LDL test done between 2-12 months post-discharge: Flag10: 1 = collect date between last discharge date+60 and last discharge date+365 0 = collect date not within timeframe Keep all records where Flag10=1	This flag identifies the individuals who had an LDL test done within a year of their discharge.	
	d	All individuals with a test result.	Some of the recorded laboratory tests were missing the test results. These individuals needed to be excluded.	
	e	Keep only the most recent test result within the time frame.	Some people have more than one LDL test within the time period. Because only one test result is needed from each person, the most recent result was used.	
LABORATORY NUMERATORS - LDL				
Flag3				

Steps		Criteria	Rationale	Date: Added
22	**a**	• LDL 2-4 Month Denominator criteria		
	b	Create flag for those who had an LDL test done between 2-4 months post-discharge: Flag3: 1 = collect date between last discharge date+60 and last discharge date+120 0 = collect date not within timeframe Keep all records where Flag3=1	This flag identifies the individuals who had an LDL test done around 3 months post-discharge. **This flag originally created the denominator for the indicator calculation, but the number of people was too small, and therefore the timeframe had to be expanded.	
	c	All individuals with a test result.	Some of the recorded laboratory tests were missing the test results. These individuals needed to be excluded.	
	d	Keep only the most recent test result within the time frame.	Some people have more than one LDL test within the time period. Because only one test result is needed from each person, the most recent result was used.	
Flag10				
23	**a**	• LDL 2-12 Month Denominator criteria		
	b	Create flag for those who had an LDL test done between 2-12 months post-discharge: Flag10: 1 = collect date between last discharge date+60 and last discharge date+365 0 = collect date not within timeframe Keep all records where Flag10=1	This flag identifies the individuals who had an LDL test done within a year of their discharge.	
	c	All individuals with a test result.	Some of the recorded laboratory tests were missing the test results. These individuals needed to be excluded.	
	d	Keep only the most recent test result within the time frame.	Some people have more than one LDL test within the time period. Because only one test result is needed from each person, the most recent result was used.	
Flag18				

Steps		Criteria	Rationale	Date: Added
24	**a**	• LDL Test Result Indicator Denominator criteria		
	b	=1 if patient has a test result between 1.8-2.5 during the 2-12 month timeframe		
Flagunder2				
25	**a**	• LDL Test Result Indicator Denominator criteria		
	b	=1 if patient has a test result <2.0 during the 2-12 month timeframe		
Flagover2				
26	**a**	• LDL Test Result Indicator Denominator criteria		
	b	=1 if patient has a test result >2.0 during the 2-12 month timeframe		
LABORATORY DENOMINATORS - INR				
INR Test Denominator				
27	**a**	• Common Criteria #1		
	b	• 90-Day Drug Denominator criteria	Since the indicators start at "3 months post-stroke", those who died before 3 months should not be included in the denominator, and therefore this dataset was utilized.	
	c	All individuals who live in the Saskatoon or Regina Qu'Appelle RHA. Keep rha=4 or rha=6	Laboratory data was only available for these RHAs. Thus, to make the indicator calculation correct, people who live outside of RHA 4 or 6 needed to be excluded from the denominator.	
	d	Keep all individuals with: Warfarinflag3=1 OR Warfarinflag90=1	Since the indicator involves the patients who are "On" warfarin therapy following discharge, keeping all individuals who are "On" warfarin at 3 or 90 days post-discharge is appropriate for this denominator.	
INR 2-4 Month Denominator				
28	**a**	• INR Test Denominator criteria		
	b	Merge the 90-Day Drug Denominator key_hsns with the current laboratory data file(s).		

Steps		Criteria	Rationale	Date: Added
	c	Create flag for those who had an INR test done between 2-4 months post-discharge: Flag3: 1 = collect date between last discharge date+60 and last discharge date+120 0 = collect date not within timeframe Keep all records where Flag3=1	This flag identifies the individuals who had an INR test done 2-4 months post-discharge.	
	d	All individuals with a test result.	Some of the recorded laboratory tests were missing the test results. These individuals needed to be excluded.	
	e	Keep only the most recent test result within the time frame.	Some people have more than one LDL test within the time period. Because only one test result is needed from each person, the most recent result was used.	
INR 5-7 Month Denominator				
29	**a**	• INR Test Denominator criteria		
	b	Merge the 90-Day Drug Denominator key_hsns with the current laboratory data file(s).		
	c	Create flag for those who had an INR test done between 5-7 months post-discharge: Flag6: 1 = collect date between last discharge date+150 and last discharge date+210 0 = collect date not within timeframe Keep all records where Flag6=1	This flag identifies the individuals who had an INR test done 5-7 months post-discharge.	
	d	All individuals with a test result.	Some of the recorded laboratory tests were missing the test results. These individuals needed to be excluded.	
	e	Keep only the most recent test result within the time frame.	Some people have more than one LDL test within the time period. Because only one test result is needed from each person, the most recent result was used.	
INR 11-13 Month Denominator				

Steps		Criteria	Rationale	Date: Added
30	**a**	• INR Test Denominator criteria		
	b	Merge the 90-Day Drug Denominator key_hsns with the current laboratory data file(s).		
	c	Create flag for those who had an INR test done between 11-13 months post-discharge: Flag12: 1 = collect date between last discharge date+330 and last discharge date+390 0 = collect date not within timeframe Keep all records where Flag12=1	This flag identifies the individuals who had an INR test done 11-13 months post-discharge.	
	d	All individuals with a test result.	Some of the recorded laboratory tests were missing the test results. These individuals needed to be excluded.	
	e	Keep only the most recent test result within the time frame.	Some people have more than one LDL test within the time period. Because only one test result is needed from each person, the most recent result was used.	
LABORATORY NUMERATORS - INR				
Flag10				
31	**a**	• INR Test Denominator Criteria		
	b	Create flag for those who had an INR test done between 2-12 months post-discharge: Flag10: 1 = collect date between last discharge date+60 and last discharge date+365 0 = collect date not within timeframe Keep all records where Flag10=1	This flag identifies the individuals who had an INR test done within a year of their discharge.	
	c	All individuals with a test result.	Some of the recorded laboratory tests were missing the test results. These individuals needed to be excluded.	

Steps		Criteria	Rationale	Date: Added
	d	Keep only the most recent test result within the time frame.	Some people have more than one LDL test within the time period. Because only one test result is needed from each person, the most recent result was used.	
2-4 Month Rangeflag				
32	**a**	• INR 2-4 Month Denominator Criteria		
	b	=1 if patient has a test result between 2.0-3.0 during the 2-4 month timeframe	The original indicator numerator asks for all those in "therapeutic range" on their INR test. According to the literature, therapeutic range is 2.0-3.0.	
5-7 Month Rangeflag				
33	**a**	• INR 5-7 Month Denominator Criteria		
	b	=1 if patient has a test result between 2.0-3.0 during the 5-7 month timeframe	The original indicator numerator asks for all those in "therapeutic range" on their INR test. According to the literature, therapeutic range is 2.0-3.0.	
11-13 Month Rangeflag				
34	**a**	• INR 11-13 Month Denominator Criteria		
	b	=1 if patient has a test result between 2.0-3.0 during the 11-13 month timeframe	The original indicator numerator asks for all those in "therapeutic range" on their INR test. According to the literature, therapeutic range is 2.0-3.0.	

APPENDIX C: LIST OF CATEGORIZED SASKATCHEWAN HOSPITALS

Saskatchewan Hospitals Classified by Hospital Category (75)

Hospital Category	Facility Name	RHA
Provincial	Saskatoon City Hospital	Saskatoon
n=6	St. Paul's Hospital	Saskatoon
	Royal University Hospital	Saskatoon
	Regina General Hospital	Regina Qu'Appelle
	Pasqua Hospital	Regina Qu'Appelle
	Plains Health Centre	Regina Qu'Appelle
	(closed November 20, 1998)	
Regional	Lloydminister Hospital	Prairie North
n=7	Moose Jaw Union Hospital	Five Hills
	Battlefords Union Hospital	Prairie North
	Holy Family Hospital	Prince Albert Parkland
	(closed October 1, 1997)	
	Victoria Hospital	Prince Albert Parkland
	Swift Current Regional Hospital	Cypress
	Yorkton Regional Health Centre	Sunrise
District	St. Joseph's Hospital	Sun Country
n=9	St. Elizabeth's Hospital	Saskatoon
	Kindersley Integrated Health Care Facility	Heartland
	Northwest Health Facility	Prairie North
	Melfort Hospital	Kelsey Trail
	St. Peter's Hospital	Sunrise
	Nipawin Hospital	Kelsey Trail
	Tisdale Hospital	Kelsey Trail
	Weyburn General Hospital	Sun Country
Community	Arborfield and District Health Care Centre	Kelsey Trail
n=109	Arcola Health Centre	Sun Country
	Assiniboia Union Hospital	Five Hills
	Balcarres Integrated Care Centre	Regina Qu'Appelle
	Beechy Health Centre	Heartland
	Bengough Health Centre	Sun Country
	Biggar Union Hospital	Heartland
	Big River Health Centre	Prince Albert Parkland
	Birth Hills Medical Centre/Birchview Nursing Home	Prince Albert Parkland
	Borden Community Health Centre	Saskatoon
	Broadview Union Hospital	Regina Qu'Appelle
	Prairie Health Care Centre	Cypress
	Canora Hospital	Sunrise
	Carrot River Health Centre	Kelsey Trail
	Central Butte Union Hospital	Five Hills
	Border Health Centre	Cypress

	Coronach Health Centre	Sun Country
	Craik and District Health Centre	Five Hills
	Cudworth Nursing Home/Health Centre	Saskatoon
	Cupar Health Centre	Regina Qu'Appelle
	Cut Knife Health Complex	Prairie North
	Davidson Health Centre	Heartland
	Dinsmore Health Care Centre	Heartland
	Eastend Wolf Willow Health Centre	Cypress
	Eatonia Health Care Centre	Heartland
	Lady Minto Health Care Centre	Prairie North
	Elrose Health Centre	Heartland
	St. Anthony's Hospital	Sunrise
	Eston Health Centre/Jubilee Lodge	Heartland
	Fillmore Union Health Centre	Sun Country
	L. Gervais Memorial Health Centre	Prairie North
	St. Joseph's Hospital	Five Hills
	Grenfell Health Centre	Regina Qu'Appelle
	Gull Lake Special Care Centre	Cypress
	Hafford Hospital and Special Care Home	Prince Albert Parkland
	Herbert Morse Hospital	Cypress
	Hudson Bay Health Care Facility	Kelsey Trail
	Long Lake Valley Integrated Facility	Regina Qu'Appelle
	Indian Head Union Hospital	Regina Qu'Appelle
	Invermay Health Centre/Gateway Lodge	Sunrise
	Ituna Pioneer Health Care Centre	Sunrise
	Kamsack Hospital/Kamsack and District Nursing Home	Sunrise
	Kelvington Hospital	Kelsey Trail
	Kerrobert Integrated Health Care Facility	Heartland
	Kincaid Health Centre	Five Hills
	Kinistino Health Centre	Prince Albert Parkland
	Kipling Memorial Health Centre	Sun Country
	Kyle and District Health Centre	Heartland
	Lafleche and District Health Centre	Five Hills
	Lampman Community Health Centre	Sun Country
	Langenburg Health Complex/Centennial Special Care Home	Sunrise
	Lanigan Hospital	Saskatoon
	Leader Hospital	Cypress
	Evergreen Health Centre	Prince Albert Parkland
	St. Joseph's Integrated Care Centre	Regina Qu'Appelle
	Loon Lake Union Hospital and Special Care Home	Prairie North
	Lucky Lake Health Care Centre	Heartland
	St. Joseph's Health Centre	Heartland
	Maidstone Hospital	Prairie North

	Prairie View Health Centre	Cypress
	Maple Creek Hospital	Cypress
	Mainprize Manor and Health Centre	Sun Country
	Montmartre Health Centre	Regina Qu'Appelle
	Providence Place	Five Hills
	Moosomin Union Hospital	Regina Qu'Appelle
	Manitou Health Centre	Prairie North
	Nokomis Health Centre/Puffer Special Care Home Corp	Saskatoon
	Norquay Health Centre/Gateway Lodge	Sunrise
	Outlook Union Hospital	Heartland
	Galloway Health Centre	Sun Country
	Pangman Health Centre	Sun Country
	Paradise Hill Hospital	Prairie North
	Ponteix Health Centre/Foyer St. Joseph Nursing Home	Cypress
	Porcupine Carragana Hospital	Kelsey Trail
	Preeceville Hospital	Sunrise
	Radville Marian Health Centre	Sun Country
	Redvers Health Centre	Sun Country
	Grasslands Health Centre	Five Hills
	Rosetown and District Health Centre	Heartland
	Rose Valley Health Centre	Kelsey Trail
	Rosthern Hospital	Saskatoon
	St. Walburg Health Complex	Prairie North
	Shaunavon Hospital and Care Centre	Cypress
	Shellbrook and District Hospital	Prince Albert Parkland
	Smeaton Health Centre	Kelsey Trail
	Spalding Community Health Centre	Kelsey Trail
	Spiritwood and District Health Complex	Prince Albert Parkland
	Theodore Health Centre	Sunrise
	Riverside Health Complex	Prairie North
	Unity and District Health Centre	Heartland
	Vanguard Health Centre	Cypress
	Wadena Hospital	Saskatoon
	Wakaw Hospital	Saskatoon
	Watrous Hospital	Saskatoon
	Watson Health Complex/Quill Plains Centennial Lodge	Saskatoon
	Wawota Memorial Health Centre/Deer View Lodge	Sun Country
	Whitewood Community Health Centre	Regina Qu'Appelle
	Wilkie and District Health Centre/Poplar Courts	Heartland
	Wolseley Memorial Union Hospital	Regina Qu'Appelle
	Wynyard Integrated Facility	Saskatoon

	Buffalo Narrow Health Centre	Keewatin Yatthé
	Cumberland House	Kelsey Trail
	Sandy Bay Health Centre	Mamawetan Churchill River
	Yutthé Dene Nakóhódí Health Centre	Athabasca Health Authority
	Pinehouse Health Centre	Mamawetan Churchill River
	Beauval Heatlh Centre	Keewatin Yatthé
	Fort Qu'Appelle Indian Hospital Inc.	Regina Qu'Appelle
Northern	St. Joseph's Hospital	Keewatin Yatthé
n=4	La Ronge Health Centre	Mamawetan Churchill River
	Uranium City Municipal Hospital *(closed June 1, 2003)*	Athabasca Health Authority
	La Loche Health Centre	Keewatin Yatthé

APPENDIX D: REVISED MEDICATION QUALITY INDICATORS

List of the revised stroke/TIA quality indicators for medications

Indicator	Numerator for Aggregate Measure	Denominator for Aggregate Measure	Rationale
2.2 vii. a. Antihypertensives 3 Days Proportion of people hospitalized for a stroke/ TIA dispensed blood pressure lowering agents as assessed at the 3rd day post-discharge.	The number of adults discharged from hospitalization for stroke/TIA who were dispensed a quantity of antihypertensives on their last dispensing date during the 3 days post-discharge to ensure they have sufficient medication for at least a minimum daily dose on the 3rd day.	The number of adults discharged alive from hospitalization for which the most responsible diagnosis is stroke/TIA during the year in which the indicator is being measured.	This process of care indicator describes whether or not the patient received an intervention that has been shown to be beneficial. This rate of adequate drug dispensing during the 3 days post-discharge is assumed to be primarily a function of drug prescribing by the hospital physician at discharge.
2.2 vii. b. ACEI 3 Days Proportion of people hospitalized for a stroke/ TIA dispensed angiotensin-converting enzyme inhibitors (ACEI) as assessed at the 3rd day post-discharge.	The number of adults discharged from hospitalization for stroke/TIA who were dispensed a quantity ACEI on their last dispensing date during the 3 days post-discharge to ensure they have sufficient medication for at least a minimum daily dose on the 3rd day.	The number of adults discharged alive from hospitalization for which the most responsible diagnosis is stroke/TIA during the year in which the indicator is being measured.	This process of care indicator describes whether or not the patient received an intervention that has been shown to be beneficial. This rate of adequate drug dispensing during the 3 days post-discharge is assumed to be primarily a function of drug prescribing by the hospital physician at discharge.

2.2 vii. c. Antihypertensives 90 Days Proportion of people hospitalized for a stroke/ TIA dispensed blood pressure lowering agents as assessed at the 90th day post-discharge.	The number of adults discharged from hospitalization for stroke/TIA who were dispensed a quantity of antihypertensives on their last dispensing date during the 90 days post-discharge to ensure they have sufficient medication for at least a minimum daily dose on the 90th day.	The number of adults discharged alive from hospitalization for which the most responsible diagnosis is stroke/TIA during the year in which the indicator is being measured.	The process of care indicator describes whether or not the patient received an intervention that has been shown to be beneficial. The rate of adequate drug dispensing during the 90 days post-discharge is a function of both drug prescribing by the hospital physician at discharge and prescribing in the primary care setting during the post-discharge period.
2.2 vii. d. ACEI 90 Days Proportion of people hospitalized for a stroke/ TIA dispensed angiotensin-converting enzyme inhibitors (ACEI) as assessed at the 90th day post-discharge.	The number of adults discharged from hospitalization for stroke/TIA who were dispensed a quantity of ACEI on their last dispensing date during the 90 days post-discharge to ensure they have sufficient medication for at least a minimum daily dose on the 90th day.	The number of adults discharged alive from hospitalization for which the most responsible diagnosis is stroke/TIA during the year in which the indicator is being measured.	The process of care indicator describes whether or not the patient received an intervention that has been shown to be beneficial. The rate of adequate drug dispensing during the 90 days post-discharge is a function of both drug prescribing by the hospital physician at discharge and prescribing in the primary care setting during the post-discharge period.
2.3 ii. a. Antilipidemics 3 Days Proportion of people hospitalized for a stroke/ TIA dispensed	The number of adults discharged from hospitalization for stroke/TIA who were dispensed a quantity of antilipidemics on	The number of adults discharged alive from hospitalization for which the most responsible diagnosis is stroke/TIA during	This process of care indicator describes whether or not the patient received an intervention that has been shown to be

lipid-lowering agents as assessed at the 3rd day post-discharge.	their last dispensing date during the 3 days post-discharge to ensure they have sufficient medication for at least a minimum daily dose on the 3rd day.	the year in which the indicator is being measured.	beneficial. This rate of adequate drug dispensing during the 3 days post-discharge is assumed to be primarily a function of drug prescribing by the hospital physician at discharge.
2.3 ii. b. Statins 3 Days Proportion of people hospitalized for a stroke/ TIA dispensed statin medication as assessed at the 3rd day post-discharge.	The number of adults discharged from hospitalization for stroke/TIA who were dispensed a quantity of statin medication on their last dispensing date during the 3 days post-discharge to ensure they have sufficient medication for at least a minimum daily dose on the 3rd day.	The number of adults discharged alive from hospitalization for which the most responsible diagnosis is stroke/TIA during the year in which the indicator is being measured.	This process of care indicator describes whether or not the patient received an intervention that has been shown to be beneficial. This rate of adequate drug dispensing during the 3 days post-discharge is assumed to be primarily a function of drug prescribing by the hospital physician at discharge.
2.3 ii. c. Antilipidemics 90 Days Proportion of people hospitalized for a stroke/ TIA dispensed lipid-lowering agents as assessed at the 90th day post-discharge.	The number of adults discharged from hospitalization for stroke/TIA who were dispensed a quantity of antilipidemics on their last dispensing date during the 90 days post-discharge to ensure they have sufficient medication for at least a minimum daily dose on the 90th day.	The number of adults discharged alive from hospitalization for which the most responsible diagnosis is stroke/TIA during the year in which the indicator is being measured.	The process of care indicator describes whether or not the patient received an intervention that has been shown to be beneficial. The rate of adequate drug dispensing during the 90 days post-discharge is a function of both drug prescribing by the hospital physician at discharge and prescribing in the primary care setting

			during the post-discharge period.
2.3 ii. d. Statins 90 Days Proportion of people hospitalized for a stroke/ TIA dispensed statin medication as assessed at the 90th day post-discharge.	The number of adults discharged from hospitalization for stroke/TIA who were dispensed a quantity of statin medication on their last dispensing date during the 90 days post-discharge to ensure they have sufficient medication for at least a minimum daily dose on the 90th day.	The number of adults discharged alive from hospitalization for which the most responsible diagnosis is stroke/TIA during the year in which the indicator is being measured.	The process of care indicator describes whether or not the patient received an intervention that has been shown to be beneficial. The rate of adequate drug dispensing during the 90 days post-discharge is a function of both drug prescribing by the hospital physician at discharge and prescribing in the primary care setting during the post-discharge period.
2.6 i. a. Anticoagulants 3 Days Proportion of people hospitalized for a stroke/ TIA with atrial fibrillation dispensed anticoagulants as assessed at the 3rd day post-discharge.	The number of adults discharged from hospitalization for stroke/TIA with atrial fibrillation who were dispensed a quantity of anticoagulants on their last dispensing date during the 3 days post-discharge to ensure they have sufficient medication for at least a minimum daily dose on the 3rd day.	The number of adults with atrial fibrillation discharged alive from hospitalization for which the most responsible diagnosis is stroke/TIA during the year in which the indicator is being measured.	This process of care indicator describes whether or not the patient received an intervention that has been shown to be beneficial. This rate of adequate drug dispensing during the 3 days post-discharge is assumed to be primarily a function of drug prescribing by the hospital physician at discharge.
2.6 i. b. Warfarin 3 Days Proportion of people hospitalized for a stroke/ TIA with atrial fibrillation dispensed warfarin as assessed at	The number of adults discharged from hospitalization for stroke/TIA with atrial fibrillation who were dispensed a quantity of warfarin on their	The number of adults with atrial fibrillation discharged alive from hospitalization for which the most responsible diagnosis is stroke/TIA during	This process of care indicator describes whether or not the patient received an intervention that has been shown to be beneficial. This

the 3rd day post-discharge.	last dispensing date during the 3 days post-discharge to ensure they have sufficient medication for at least a minimum daily dose on the 3rd day.	the year in which the indicator is being measured.	rate of adequate drug dispensing during the 3 days post-discharge is assumed to be primarily a function of drug prescribing by the hospital physician at discharge.
2.6 i. c. Anticoagulants 90 Days Proportion of people hospitalized for a stroke/ TIA with atrial fibrillation dispensed anticoagulants as assessed at the 90th day post-discharge.	The number of adults discharged from hospitalization for stroke/TIA with atrial fibrillation who were dispensed a quantity of anticoagulants on their last dispensing date during the 90 days post-discharge to ensure they have sufficient medication for at least a minimum daily dose on the 90th day.	The number of adults with atrial fibrillation discharged alive from hospitalization for which the most responsible diagnosis is stroke/TIA during the year in which the indicator is being measured.	The process of care indicator describes whether or not the patient received an intervention that has been shown to be beneficial. The rate of adequate drug dispensing during the 90 days post-discharge is a function of both drug prescribing by the hospital physician at discharge and prescribing in the primary care setting during the post-discharge period.
2.6 i. d. Warfarin 90 Days Proportion of people hospitalized for a stroke/ TIA with atrial fibrillation dispensed warfarin as assessed at the 90th day post-discharge.	The number of adults discharged from hospitalization for stroke/TIA with atrial fibrillation who were dispensed a quantity of warfarin on their last dispensing date during the 90 days post-discharge to ensure they have sufficient medication for at least a minimum daily dose on the 90th day.	The number of adults with atrial fibrillation discharged alive from hospitalization for which the most responsible diagnosis is stroke/TIA during the year in which the indicator is being measured.	The process of care indicator describes whether or not the patient received an intervention that has been shown to be beneficial. The rate of adequate drug dispensing during the 90 days post-discharge is a function of both drug prescribing by the hospital physician at discharge and

			prescribing in the primary care setting during the post-discharge period.

APPENDIX E: DRUG USE METHODOLOGY (75)

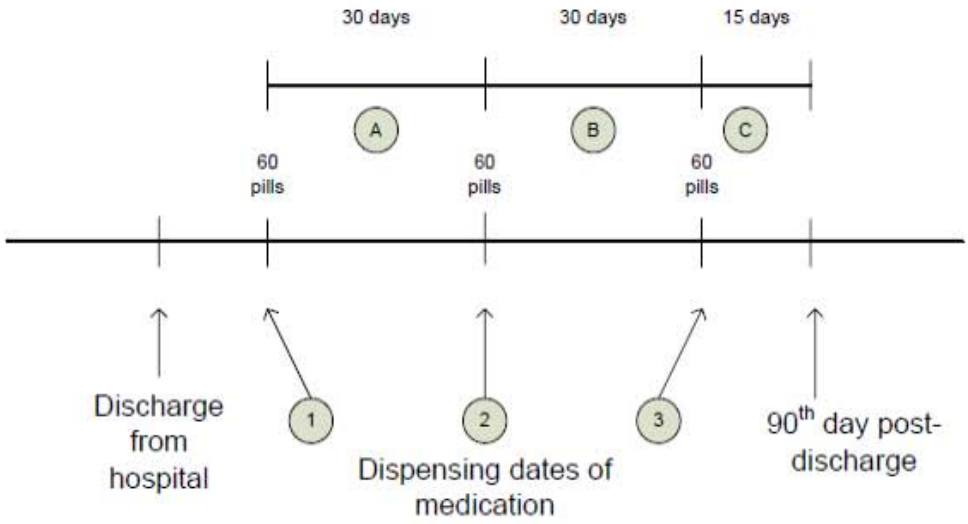
Drug Use

The medication use quality indicators are based on ascertainment of whether patients are (likely) taking the drug at the date of interest (i.e., 3, 90, or 365 days post-discharge). Since the indicator is based on pharmaceutical dispensing data, we need a methodology for estimating whether a patient will have a sufficient supply of the medication at the date of interest. To do this, we inferred, based on the amount of medication dispensed, the number of pills a patient was to take daily and

calculated whether they would have sufficient drug supply remaining from the dispensing date pri to the date of interest (i.e. 3, 90 or 365 days post-discharge).

The expected number of pills to be taken each day during the period between the most recent dispensing prior to the date of interest and the date of interest itself was inferred based on the number of pills dispensed to that person in recent prior history as shown in Figure 2.2.

Figure 2.2: Example of how daily pill count is inferred



To infer the number of pills to be taken per day during period C, leading up to the 90th day post-discharge, the average number of daily pills in periods A and B were calculated as the sum of the pills dispensed on dates 1 and 2 divided by the number of days between dispensing dates 1 and 3.

So, in this example,

60 + 60 / 60 = 2 pills /day.

At the expected rate of usage of 2 pills per day, the 60 pills dispensed at time 3 would be expected to last well beyond the 15 days between dispensing 3 and the date of interest (90th day post-discharge); so the patient would be counted in the indicator numerator (as being on the medication at the 90th day post-discharge).

Based on the inferred daily pill count (or a minimum count of a half-pill per day for beta-blockers and one pill per day for the other medications used in the post-AMI report), we calculate when the patient would run out of pills. If the time from the last prior dispensing to the 90th day post-discharge is fewer days than the number of days of available drug, we conclude that the patient was on the particular medication on the 90th day post-discharge. On the other hand, if the drug count indicates that the patient did run out of pills before the 90th day post-discharge, then our conclusion is that the patient was not on the particular medication on the 90th day post-discharge.

Again, knowing that the minimum drug count should be half or one pill a day (depending on the specific drug), if the calculated average pill frequency was less than the minimum dose, or if there were no previous prescriptions, then the pill frequency for the patient defaulted to the assumed lowest frequency.

Hospital days are subtracted from that interval, as medications are covered in hospital stays. Refills are taken into account by extending the interval by the appropriate number of pills (depending on the assumed lowest frequency).

For all drug use indicators, the time period that the patient was on a specific drug is calculated by the date of service (drug dispensing) occurred.

Figure 2.3 presents the way drug use is determined on 3, 90, and 365 days post-discharge. Day 0 indicates the discharge date, and the lines represent the time period during which the patient was dispensed the drug. Note that individuals can qualify for inclusion in indicators for several of the time periods post-discharge. The patients in Figure 2.3 are listed in Table 2.2 to show which are included in the 3-day, 90-day, and 365-day drug indicators. For example, Patients A, B, and C are considered taking the drug during the first time period only, and therefore included only in the 3-day indicator. Patients P, R, and S are considered taking the drug during the second time period, and included for 90-day drug indicator. However, patients R and S were also taking the drug during the first 3 days after discharge, so they would also included in the 3-day indicator. Similarly while patient X is included only in the 365-day drug indicator, patient Y is included both in 90- and 365-day drug indicators, and patient Z is included in indicators for all three periods.

Figure 2.3: Drug use on 3, 90, and 365 days post-discharge

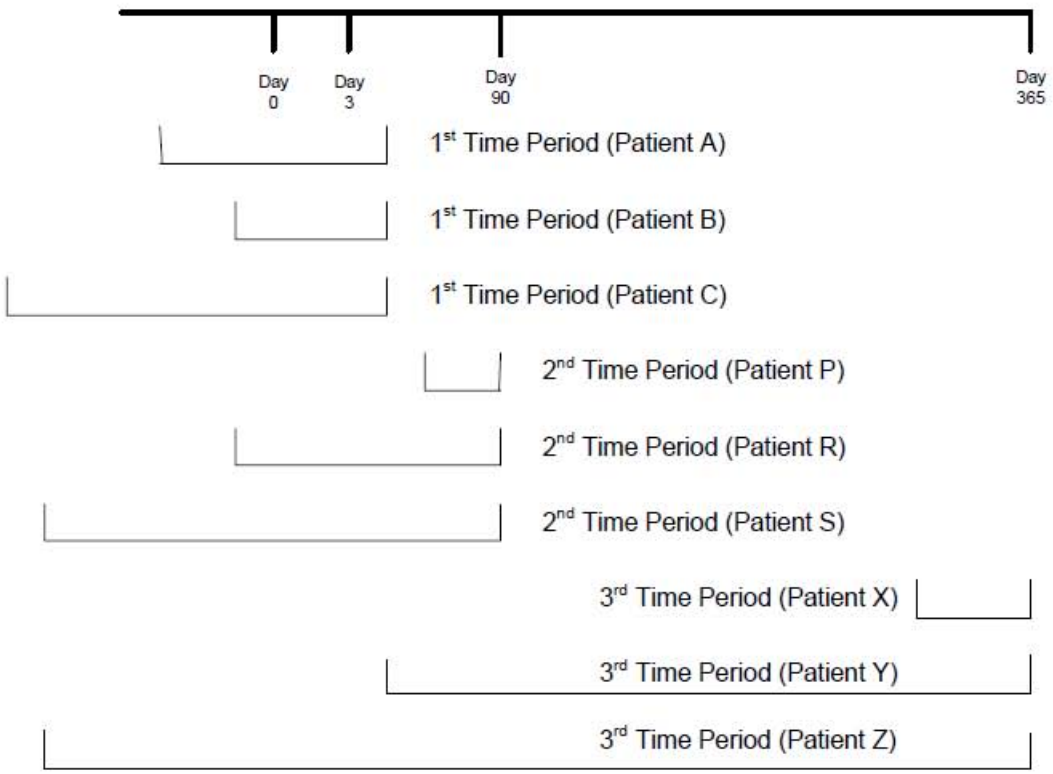


Table 2.2 Patients included in 3-day, 90-day, and 365-day drug indicators

Patients	Drug use on 3 days post-discharge	Drug use on 90 days post-discharge	Drug use on 365 days post-discharge
A	x		
B	x		
C	x		
P		x	
R	x	x	
S	x	x	
X			x
Y		x	x
Z	x	x	x

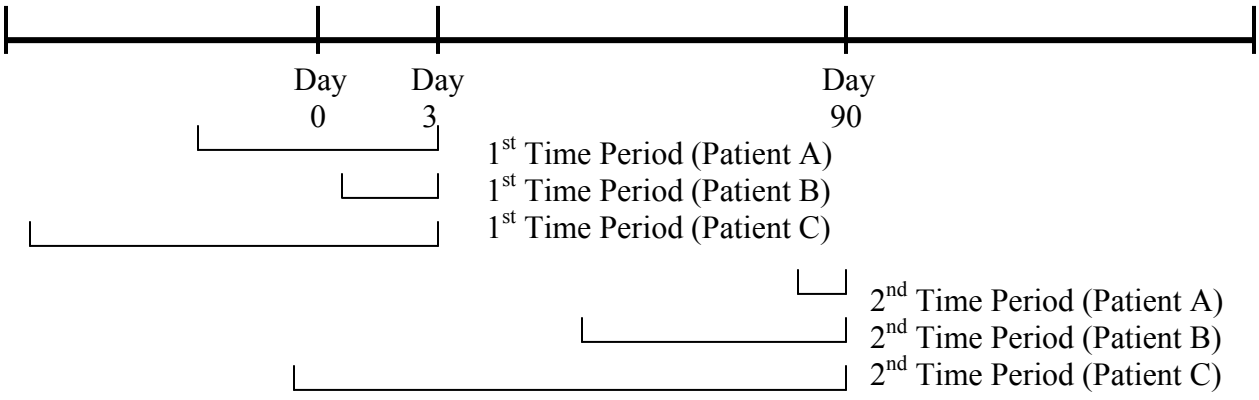
APPENDIX F: EXPLANATION OF DRUG RULE 4 (75)

Drug Rule 4
This is otherwise known as the **'inferred frequency rule'**. For each prescription in the drug database, we infer the pill frequency as follows. We examine the previous two prescriptions dispensed for the same medication and calculate the average pill frequency over those two prescriptions. The average pill frequency is equal to the total number of pills dispensed in those two prescriptions, divided by the number of days elapsed between the third prescription date and the earlier of the previous two prescriptions.

If previous prescriptions were not written, then the half pill, or one pill depending on which drug was dispensed, frequency assumption applies. The intent, as above in drug rule 3, is to ascertain if the patient is taking the drug at the date of interest (3 or 90days).

Hospital days are subtracted from that interval, as medications are covered in a hospital stay. Refills are taken care of by extending the interval by the appropriate number of pills (depending on the assumed lowest frequency).

The main difference between drug rule 3 and drug rule 4, is, instead of assuming what the pill frequency is, we are calculating the frequency based on the patients' previous two prescriptions, and using that pill frequency to calculate the time period. Drug rule 3 is liberal is its assumption of the pill frequency, and therefore drug rule 4 is likely to be more accurate.



APPENDIX G: REVISED LABORATORY TEST QUALITY INDICATORS

List of the revised stroke/TIA quality indicators for laboratory tests

Indicator	Numerator for Aggregate Measure	Denominator for Aggregate Measure	Rationale
2.3 a. **LDL-C Test at 2-4 Months** Proportion of stroke/TIA patients given an LDL-C test between 2-4 months following their stroke event	The number of adults who live in Saskatoon/Regina Qu'Appelle discharged from hospitalization for stroke/TIA with at least one LDL-C test result (most recent) 2-4 months post-discharge.	The number of adults who live in Saskatoon/Regina Qu'Appelle discharged from hospitalization for stroke/TIA (most responsible diagnosis) and alive at 90 days.	The LDL-C levels of stroke/TIA patients should be monitored following discharge from hospital. The intermediate outcome indicator describes whether or not stroke/TIA patients are being given LDL-C tests, and therefore being monitored, at the recommended 3 months post-discharge.
2.3 b. **LDL-C Test at 2-12 Months** Proportion of stroke/TIA patients given an LDL-C test between 2-12 months following their stroke event	The number of adults who live in Saskatoon/Regina Qu'Appelle discharged from hospitalization for stroke/TIA with at least one LDL-C test result (most recent) 2-12 months post-discharge.	The number of adults who live in Saskatoon/Regina Qu'Appelle discharged from hospitalization for stroke/TIA (most responsible diagnosis) and alive at 90 days.	The LDL-C levels of stroke/TIA patients should be monitored following discharge from hospital. The intermediate outcome indicator describes whether or not stroke/TIA patients are being given LDL-C tests, and therefore being monitored post-discharge.

2.3 iii. **LDL-C 1.8-2.5** Proportion of stroke/TIA patients with a most recent LDL-C level between 1.8-2.5 at 2-12 months following their stroke event	The number of adults who live in Saskatoon/Regina Qu'Appelle discharged from hospitalization for stroke/TIA with a most recent LDL-C result between 1.8-2.5 at 2-12 months post-discharge.	The number of adults who live in Saskatoon/Regina Qu'Appelle discharged from hospitalization for stroke/TIA who had at least one LDL-C test (most recent) between 2-12 months post-discharge.	The recommended LDL-C target level for people who have had a stroke or TIA should be less than 2.0mmol/L. The intermediate outcome indicator describes whether or not the LDL-C levels of stroke/TIA patients are within the recommended range.
2.3 iv. **LDL-C <2.0** Proportion of stroke/TIA patients with a most recent LDL-C level less than 2.0 at 2-12 months following their stroke event	The number of adults who live in Saskatoon/Regina Qu'Appelle discharged from hospitalization for stroke/TIA with a most recent LDL-C result less than 2.0 at 2-12 months post-discharge.	The number of adults who live in Saskatoon/Regina Qu'Appelle discharged from hospitalization for stroke/TIA who had at least one LDL-C test (most recent) between 2-12 months post-discharge.	The recommended LDL-C target level for people who have had a stroke or TIA should be less than 2.0mmol/L. The intermediate outcome indicator describes whether or not the LDL-C levels of stroke/TIA patients are within the recommended range.
2.3 v. **LDL-C >2.0** Proportion of stroke/TIA patients with a most recent LDL-C level greater than 2.0 at 2-12 months following their stroke event	The number of adults who live in Saskatoon/Regina Qu'Appelle discharged from hospitalization for stroke/TIA with a most recent LDL-C result greater than 2.0 at 2-12 months post-discharge.	The number of adults who live in Saskatoon/Regina Qu'Appelle discharged from hospitalization for stroke/TIA who had at least one LDL-C test (most recent) between 2-12 months post-discharge.	The recommended LDL-C target level for people who have had a stroke or TIA should be less than 2.0mmol/L. The intermediate outcome indicator describes whether or not the LDL-C levels of

			stroke/TIA patients are within the recommended range.
2.6 v. a. **INR Test at 2-12 Months** Proportion of stroke/TIA patients given at least one INR test between 2-12 months following their stroke event	The number of adults who live in Saskatoon/Regina Qu'Appelle discharged from hospitalization for stroke/TIA and placed on warfarin with at least one INR test result between 2-12 months post-discharge.	The number of adults who live in Saskatoon/Regina Qu'Appelle discharged from hospitalization for stroke/TIA who were placed on warfarin.	The INR levels of stroke/TIA patients should be monitored following placement on warfarin. The intermediate outcome indicator describes whether or not stroke/TIA patients are being given INR tests, and therefore being monitored post-discharge.
2.6 v. b. **INR 2.0-3.0 at 2-4 Months** Proportion of stroke/TIA patients on warfarin with a most recent INR level between 2.0-3.0 at 2-4 months following their stroke event	The number of adults who live in Saskatoon/Regina Qu'Appelle discharged from hospitalization for stroke/TIA and placed on warfarin with a most recent INR result between.2.0-3.0 at 2-4 months post-discharge.	The number of adults who live in Saskatoon/Regina Qu'Appelle discharged from hospitalization for stroke/TIA who were placed on warfarin and had at least one INR test (most recent) between 2-4 months post-discharge.	The recommended target INR level for people who have had a stroke or TIA is 2.5 (range 2.0-3.0). The intermediate outcome indicator describes whether or not the INR levels of stroke/TIA patients on warfarin are within the recommended range around 3 months post-discharge.
2.6 v. c. **INR 2.0-3.0 at 5-7 Months** Proportion of stroke/TIA patients	The number of adults who live in Saskatoon/Regina Qu'Appelle discharged from hospitalization	The number of adults who live in Saskatoon/Regina Qu'Appelle discharged from hospitalization	The recommended target INR level for people who have had a stroke or TIA is 2.5 (range 2.0-

on warfarin with a most recent INR level between 2.0-3.0 at 5-7 months following their stroke event	for stroke/TIA and placed on warfarin with a most recent INR result between.2.0-3.0 at 5-7 months post-discharge.	for stroke/TIA who were placed on warfarin and had at least one INR test (most recent) between 5-7 months post-discharge.	3.0). The intermediate outcome indicator describes whether or not the INR levels of stroke/TIA patients on warfarin are within the recommended range around 6 months post-discharge.
2.6 v. d. **INR 2.0-3.0 at 11-13 Months** Proportion of stroke/TIA patients on warfarin with a most recent INR level between 2.0-3.0 at 11-13 months following their stroke event	The number of adults who live in Saskatoon/Regina Qu'Appelle discharged from hospitalization for stroke/TIA and placed on warfarin with a most recent INR result between.2.0-3.0 at 11-13 months post-discharge.	The number of adults who live in Saskatoon/Regina Qu'Appelle discharged from hospitalization for stroke/TIA who were placed on warfarin and had at least one INR test (most recent) between 11-13 months post-discharge.	The recommended target INR level for people who have had a stroke or TIA is 2.5 (range 2.0-3.0). The intermediate outcome indicator describes whether or not the INR levels of stroke/TIA patients on warfarin are within the recommended range around 12 months post-discharge.